Duke University Libraries
D01853033N

Fungi of the Duke Forest

Wolf

DUKE
UNIVERSITY

LIBRARY

SCHOOL OF FORESTRY

DUKE UNIVERSITY
SCHOOL OF FORESTRY
BULLETIN 2

FUNGI OF THE DUKE FOREST

AND THEIR RELATION TO FOREST PATHOLOGY

BY

FREDERICK A. WOLF

WITH THE COLLABORATION OF

K. H. GARREN AND J. K. MILLER

DURHAM, NORTH CAROLINA
AUGUST, 1938

FUNGI OF THE DUKE FOREST

AND THEIR RELATION TO FOREST PATHOLOGY

Digitized by the Internet Archive
in 2023 with funding from
Duke University Libraries

https://archive.org/details/fungiofdukefores00wolf

DUKE UNIVERSITY
SCHOOL OF FORESTRY
BULLETIN 2

FUNGI OF THE DUKE FOREST

AND THEIR RELATION TO FOREST PATHOLOGY

BY

FREDERICK A. WOLF
Professor of Botany, Duke University

WITH THE COLLABORATION OF

K. H. GARREN AND J. K. MILLER

DURHAM, NORTH CAROLINA
AUGUST, 1938

PRINTED IN THE UNITED STATES OF AMERICA BY
THE SEEMAN PRINTERY, DURHAM, NORTH CAROLINA

634.906
D877F
No. 2
cop. 2
School of Forestry

CONTENTS

Page

FOREWORD 7
INTRODUCTION 9
SOME GENERAL CONSIDERATIONS OF FUNGI 17
The slime molds or Myxomyctes 18
The algal fungi or Phycomycetes 20
The sac fungi or Ascomycetes 20
Pyrenomycetes 20
Discomycetes 21
The basidium fungi or Basidiomycetes 22
The lower Basidiomycetes 23
The higher Basidiomycetes 23
Clavariaceae 23
Thelephoraceae 23
Smothering disease of seedlings 24
Decay of felled pine 26
Hydnaceae 27
Polyporaceae 27
Heartwood rotting polypores 28
Decay of felled timber 30
Agaricaceae 33
Identification 33
Important gill fungi 33
The imperfect fungi or Fungi Imperfecti 35
Mycorrhizae 36
THE MORE IMPORTANT FUNGI CAUSING TREE DISEASES AND DECAYS IN THE DUKE FOREST 44
Alder 44
Die back 44
Ashes 44
Leaf blight 44
Leaf spot 46
Beech 47
Black sponge 47
Decay of branches 47
Buckeye 47
Leaf blotch 47
Cedar 49
Root and butt rot 49
Rusts 49
Leaf spot 52
Cherries 54
Leaf blister or leaf curl 54
Shot hole 55
Black knot 56
Elms 56
Elm leaf scab 56
Twig rot 56
Slime flux 56

354117

White pustule spot 58
Powdery mildews 59
Sweet gum 60
Red leaf spot 60
Cercospora leaf spot 60
Twig decay and wood rot 60
Hickories 60
White spot 60
Hollies 61
Black spot 61
Tar spot 61
Honey locust 62
Tar spot 62
Black locust 63
Powdery mildew 63
Maples 64
Tar spot 64
Gray spot 64
Anthracnose 64
Mulberry 65
Leaf spots 65
Oaks 65
Oak leaf curl or leaf blister 65
Purple blotch 67
Powdery mildew 68
Rusts 68
Decays 68
Smooth patch 74
Pines 74
Needle cast 74
Needle rusts 76
Stem rust 78
Brown spot 78
Red ring-rot 78
Tulip poplar 84
Gray leaf spot 84
Powdery mildew 84
Twig decay 84
Slime flux 84
Red bud 85
Leaf spot 85
Dwarf Sumac 86
Leaf curl 86
Leaf spot 86
Sycamore 87
Anthracnose 87
Sooty leaf blight 87
Black willow 89
Rust 89
Fir-fern rust 91
LIST OF FUNGI 94
HOST INDEX 113

FOREWORD

This publication is the second in the series of forestry bulletins published by Duke University. Since the appearance of Bulletin 1 a graduate school of forestry has been established, which will cause some change in the relative emphasis upon forestry work at Duke University. The aims and objects of the series, however, remain unchanged and additional bulletins on scientific and technical subjects will be forthcoming.

C. F. KORSTIAN, *Dean.*
School of Forestry.

354117

FUNGI OF THE DUKE FOREST

AND THEIR RELATION TO FOREST PATHOLOGY

INTRODUCTION

In a recent bulletin Korstian and Maughan (1935) outlined the practices of management and operation that have been designed to make the Duke Forest a demonstration and research laboratory in certain phases of forestry. If silvicultural practices are to be brought to a successful culmination, proper consideration must be given, as is well recognized, to the role of fungi and of fungous diseases in the life of a forest. It is obvious, for example, that the fungi which accomplish the disintegration of the litter upon the forest floor are beneficial. It would appear, furthermore, that certain fungi that are pathogenic may be very detrimental, that others may be responsible for no material damage, that others may be rendering the culture of certain species of trees unprofitable, and that still others might become so destructive that the epidemic would terminate only with the extinction of certain tree species. These general relationships and their application to silviculture are emphasized by Borthwick (1925), Boyce (1929, 1938), Hiley (1925), and Meinecke (1916, 1925).

Within recent years the general public has begun to regard the planting, cultivation, growing, and harvesting of forest trees as a practice comparable with the production of cotton, corn, potatoes, tobacco, or of any other field, orchard, or garden crop. It has not yet become appreciative, however, of the value that might accrue from studies of the agencies that militate against the vigor of forest-tree crops and cause the decay of timber. Such studies appropriately come within the province of forest pathology. The utilitarian aspects of such a science become apparent if it is recalled that approximately one-fifth of all timber annually removed from our forests is destroyed by wood-rotting fungi, half of which could be prevented by application of measures now known.

As yet forest pathology does not occupy a well-established position among the botanical sciences, and its potential value is still not fully appreciated. The reasons for this state of affairs are near at hand. Foremost, perhaps, is the fact that forest pathology has not long been among the disciplines of schools of forestry. In the past and even at the moment the major emphasis in most courses in forest pathology is laid not upon the pathological aspects of tree diseases but upon the mycological aspects. This is the case also, but to a lesser extent, with courses dealing with diseases of agronomic

and horticultural plants. Another related reason, perhaps a more fundamental one, has an historical basis. It may be recalled that forest pathology had its beginning in the 1870's with the classical studies of Hartig (1874, 1878, 1882). Hartig's emphasis fell quite naturally upon the mycological aspects of the problems, since the belief was still generally held, in the case of heartwood rots and

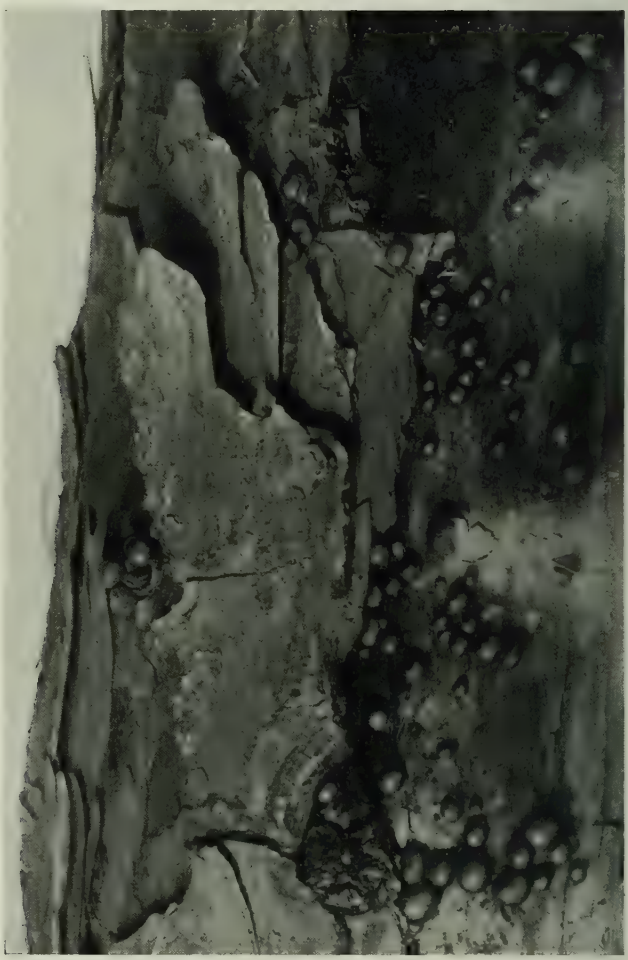

Fig. 1. *Lycogala epidendrum* (L.) Fr. on pine log. The fructifications of this slime mold resemble puff-balls.

sapwood rots, that some derangement in the tree caused it to generate the fungi. His investigations established the fact that the fungi are separate organisms capable of reproducing themselves, and that decays are the consequence of the parasitic and pathogenic habits of specific fungi. Within the period of thirty years thereafter a small number of investigators devoted a limited amount of time and effort to studies of tree diseases.

The real beginning of systematic studies of forest-tree diseases within the United States dates from 1907. In that year the Office of Forest Pathology was established within the Bureau of Plant Industry, United States Department of Agriculture. In the short period of 30 years that have since elapsed, the foundations of

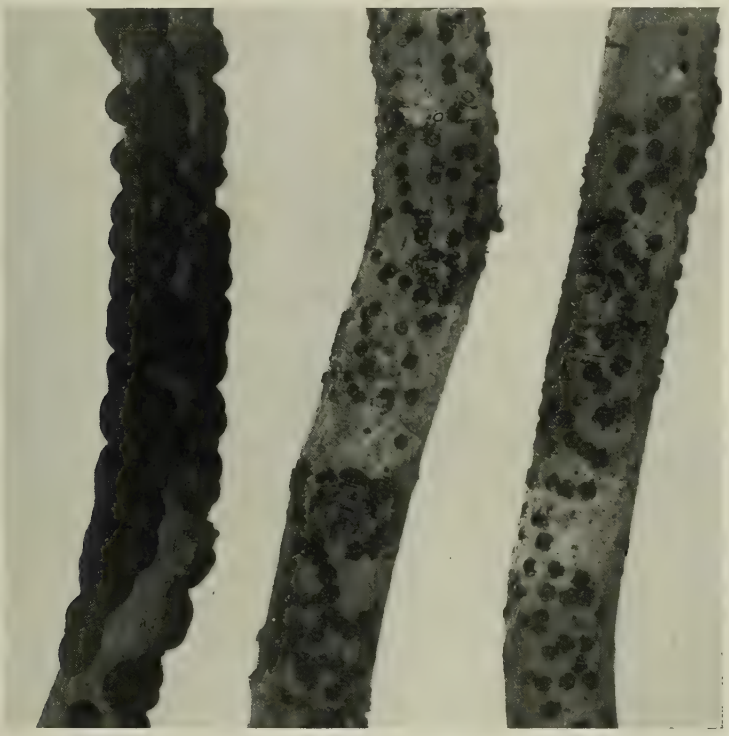

Fig. 2. Black perithecial stromata of *Hypoxylon truncatum* (Schw.) Miller on oak branch.
Branches of beech bearing the greenish stromata of *Diatrype virescens* (Schw.) E. & E.

the science of forest pathology have been laid, but the superstructure is only in the building. At present many of the fundamental studies on tree diseases, although valuable in themselves, appear to be wholly unrelated. At any rate, a body of specific knowledge of forest-tree diseases is required before any one can intelligently employ this information in silvicultural practices as related to a particular area, such as the Duke Forest. Among the significant problems the solution of which would appear helpful are the following: (1) What species may be employed in reforestation with assurance that they will remain sufficiently free from diseases as to yield a profitable return? (2) Are pure stands or mixed stands preferable in reforestation from the standpoint of incidence of diseases? (3) How will the incidence of diseases be modified by thinning? (4) Does pruning modify the losses from diseases? (5) What diseases occur only on young trees, or only on old trees? (6) What sanitary measures could be employed profitably after felling operations? (7) At what age should each of the principal tree species be felled particularly with reference to incidence of heartwood rots and sapwood rots? (8) What diseases are factors in reforestation? (9) What is the effect of site upon the incidence of diseases? (10) What are the suscept ranges of the more important pathogenic organisms? (11) What environmental factors are most important in the decay of cordwood, logs, and lumber from the different tree species? (12) What is the present status of tree-disease problems within the Duke Forest?

The answers to these and similar questions that might be raised, would appear to be fundamental and to be applicable to surrounding areas with similar forest cover, and they might even have a wide regional usefulness. It is the purpose of the present bulletin to record the fungi collected in the Duke Forest during the past six years, not as an end in itself, but to utilize these observations in orienting and evaluating what appear to be the most important forest pathological problems. It is realized, at the outset, that the work to date in the Duke Forest has been mainly exploratory. It has consisted largely of the collection and cataloguing of fungi found within the Forest. This procedure is the traditional first step, but it is, nevertheless, an essential one if a beginning is to be made. Obviously the greater proportion of the species of fungi that would be encountered in making collections are of little or no importance as pathogens. It is known, as indicated by Ramsbottom (1935), that many forest fungi are scavengers and that they decompose logs, stumps,

branches, and leaf-litter, transforming them into soil. There are those who advocate the removal of litter for the sake of tidiness and because litter constitutes a copious source of fungi—all fungi being regarded with disfavor. Some of the species that have been found are of mycological interest only. Others, although parasitic, are producing negligible damage. It is realized, however, that the possibility exists of inconsequential pathogens becoming of importance if related tree species are introduced or if environmental factors are disturbed through modification by silvicultural practices. Still other species found are well known as destructive agents in forests. No criterion is known at present for evaluating the relative importance of these disease-producing organisms. As Meinecke (1917) indicates, the importance of any given disease is based, among other things, upon such factors as (a) economic value of the tree species, (b) aggressiveness of the pathogen, (c) character of the injury, and (d) prevalence of the disease.

The list of fungi included herein contains all identified species in the Duke collections. Many additional species, especially of Agaricaceae, Boleteae, and Clavariaceae, should occur in this area, as indicated by the records of Coker and his associates; and a considerable number, in fact, have been collected but have not been included because of uncertainty in identification. Full data on collections are not given, since many of the species have been collected scores of times every year, and since such data are regarded as cumbersome and of little real value in this type of report. The list is not limited to species occurring on woody plants because herbaceous plants are ecologically a part of the forest, and because certain herbaceous species are alternate hosts for certain of the rusts. Invaluable aid in identification has been given especially by Dr. D. H. Linder, Farlow Herbarium, Cambridge, Mass., and Dr. F. J. Seaver, New York Botanical Garden, New York, N. Y. Some of the Pyrenomycetes were identified by Dr. J. H. Miller, University of Georgia, Athens, Ga., and species of Poria by Dr. D. V. Baxter, School of Forestry and Conservation, University of Michigan, Ann Arbor, Michigan. To each our gratitude is herewith expressed. Specimens of the Discomycetes have been deposited in the herbarium of the New York Botanical Garden, and specimens of a large proportion of all other species have been deposited in the Farlow Herbarium, and in the Mycological Collections of the United States Department of Agriculture.

Consideration will be given to the more important pathological problems suggested by the collections and observations, and to an evaluation of the status of available knowledge of certain specific tree diseases. The orientation of these problems should be of im-

Fig. 3. Brown scale, Lecanium sp., on mulberry parasitized by *Cordyceps clavulata* (Schw.) E. & E.

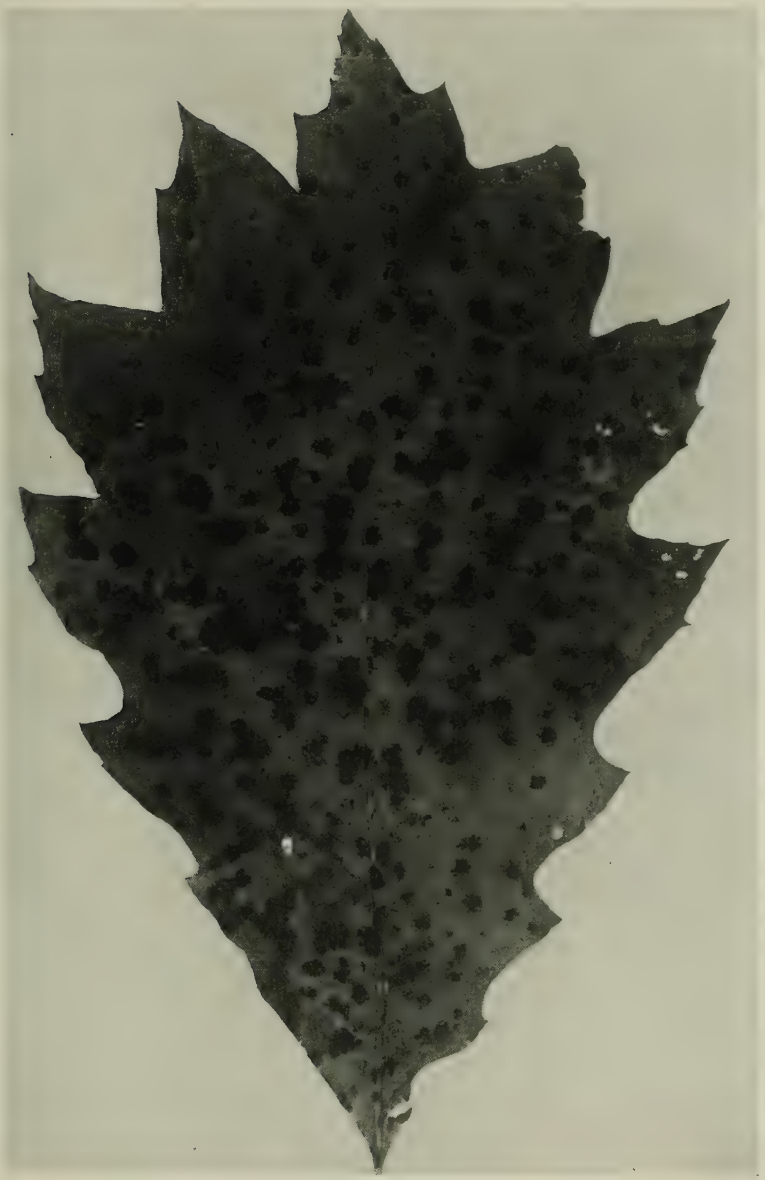

FIG. 4. Purple blotch is very prevalent on black oak, northern red oak, and blackjack oak. The causal organism is *Aulographum quercinum* Ell. & Mart.

mediate value to persons interested in studies in forest pathology in its broadest aspects, and to students pursuing specific researches in diseases of forest trees. It should also be valuable as an historic record in view of the fact that the relative importance of specific diseases may be expected to change with the passing years. Attention will be called to the need for studies on the life history of certain fungi, especially of those that cause leaf and twig diseases. Information obtained from studies of this type is fundamental to rational application of palliative, remedial, or control measures. The emphasis remains largely on the mycological aspect. Eventually such information should find direct application in modifying the productiveness of forests and in determining the best silvicultural practices.

REFERENCES

Borthwick, A. W. 1925. The relation of forest pathology to silviculture. *Rept. Imp. Bot. Conf.* London, 1924: 176-182.

Boyce, J. S. 1929. The future of forest parasites in the United States. *Jour. Forestry* **27**: 138-142.

———. 1938. Forest pathology. VII + 600 pp. New York, McGraw-Hill Book Co.

Hartig, R. 1874. Wichtige Krankheiten der Waldbäume. VII + 127 pp. Berlin, Julius Springer.

———. 1878. Die Zersetzungserscheinungen des Holzes der Nadelholzbäume und der Eiche in forstlicher, botanischer und chemischer Richtung. VI + 151 pp. Berlin, Julius Springer.

———. 1882. Lehrbuch der Baumkrankheiten. 198 pp.

Hiley, W. E. 1925. The relation of forest pathology to silviculture. *Rept. Imp. Bot. Conf.* London, 1924: 182-196.

Korstian, C. F. and W. Maughan. 1935. The Duke Forest: A demonstration and research laboratory. *Duke Univ. Forestry Bul.* **1.** 74 pp.

Meinecke, E. P. 1916. Forest pathology in forest regulation. *U. S. Dept. Agr. Bul.* **275.** 62 pp.

———. 1917. Basic problems in forest pathology. *Jour. Forestry* **15**: 215-224.

———. 1925. Forest protection diseases. *Jour. Forestry* **23**: 260-267.

Ramsbottom, J. 1935. Fungi and forestry. *Scot. Forestry Jour.* **49**: 34-51.

SOME GENERAL CONSIDERATIONS OF FUNGI

It is very apparent to the student of forest pathology that progress in this field of science is definitely limited unless investigators have a working knowledge of the fungi. This necessitates, as a minimum, acquaintance with the taxonomic aspects of the larger groups and a familiarity with the use of keys for identification. Without a working knowledge an investigator would be compelled to proceed by

Fig. 5. Above, three branches of ash encrusted with the black fruiting bodies of *Septobasidium curtisii* (B. & D.) Boed. & Steinm. Common also on black gum, beech, and dogwood.
Below, branch of elm encrusted with the grayish brown sporophore of *Septobasidium pseudopedicellatum* Burt.

empirical methods. With such knowledge rational procedures are apparent in such problems, for example, as relate to the role of fungi in the decomposition of forest litter; to the proper choice and use of sanitary practices, including thinning, pruning, and removal of slash; to proper choice of species in reforestation; to the selection of suitable nursery sites; and to mycorrhizal relationships. The mycological aspects and implications in the present study appear, therefore, to warrant special consideration. This can best be accomplished by brief separate treatment of each of the larger groups of fungi, especially those which contain species parasitic or saprophytic on trees.

No magical formula exists by means of which a working knowledge of forest fungi can be acquired. A formal introduction to forest fungi begins by finding them in their natural habitats and collecting them. Structural features can be learned by macroscopic and microscopic examination. The knowledge gained in this way may then be utilized through employment of keys for identification. By use of such keys the fungi can be traced to their natural or artificial relationships within classes, orders, families, genera, and eventually species groupings. Extensive library facilities are not essential. In the present investigation certain treatises, to which reference will be made, have been found useful. Many of these are monographic in nature, and others contain the results of less extensive special studies. Furthermore, lists of bibliographic references which the cited literature contains may become most serviceable in broadening acquaintanceship in the field of forest pathology.

No consideration will be given to the smuts, none of which occur on trees, nor to the rusts, whose species parasitic to trees will be accorded notice subsequently, nor to the Gasteromycetes, none or very few of which attack living trees, although some species aid in decay of litter.

THE SLIME MOLDS OR MYXOMYCETES

Members of a group of organisms known as the slime molds cannot have escaped the notice of foresters. They form rather conspicuous tufted patches usually on logs already badly decomposed. Each patch is an aggregate of the fructifications of the slime-mold organism. Some species are characterized by distinctive colors. Although they commonly occur on badly decayed logs, there is little evidence that they can utilize wood as food. Instead, they subsist upon the fungi that have been instrumental in causing the wood to

Fig. 6. A jelly fungus, *Exidia recisa* (Dittm.) Fr. At left, appearance in dry weather; at right, after rains.

decay. Their vegetative or plasmodial phase is motile, and only appears at the surface to form the fruiting structures. These fructifications may occur either at the surface or within the decaying vegetable matter. The vegetative phase, immediately before fruiting, may migrate to near-by vegetation and ascend stems to a point several inches above the ground level.

Approximately one-tenth of all known species of slime molds have been collected in the Duke Forest. Most of the remaining species

no doubt could be found to occur here, since slime molds are among the most cosmopolitan of organisms. Certain species are seasonal and others may be found throughout the entire year. They are most abundant after rainy periods. Recent studies involving laboratory culture of slime molds have added to our knowledge of them. Additional studies of their food habits, however, should be made to clarify our understanding of their place in the economy of nature.

THE ALGAL FUNGI OR PHYCOMYCETES

Our list of the fungi in this class includes only the parasitic members that have been observed. Several members of the water molds (Saprolegniales) among the genera Saprolegnia and Achlya, and of the black molds (Mucorales) among the genera Rhizopus, Mucor, Zygorrhynchus, and Thamnidium, have on several occasions been isolated from leaf litter. Their relationship to decomposition of litter and to soil fertility is unknown and should be given attention. None of the Phycomycetes in this area are known to produce serious diseases of trees, except species of Pythium that cause damping off of seedlings. Certain species of this genus are virtually cosmopolitan in distribution. Their identification may be facilitated by the monographic studies of Matthews (1931). Use may be made of Coker's monograph (1923) and that of Coker and Matthews (1937) in identification of the water molds.

THE SAC FUNGI OR ASCOMYCETES

Only brief mention need be made of two of the larger groups of Ascomycetes, namely, Pyrenomycetes and Discomycetes. The fruit-bodies or ascocarps of the former are flask-shaped and at maturity open with a pore, whereas those of the latter are disc-shaped.

The *Pyrenomycetes.* The former group, including the orders Dothidiales, Hypocreales, and Sphaeriales of this list, contains many species that are either leaf or stem parasites, or else cause decay of wood. Many of those that are parasitic have been more or less extensively investigated. The wood-destroying species have been almost completely neglected, except from the taxonomic viewpoint. These wood-destroying fungi present ample opportunity for research. It would be valuable to know something of their physiology, their enzyme-secreting powers, and the influence of environmental factors in modifying the rate of decay. In particular, the frequently ob-

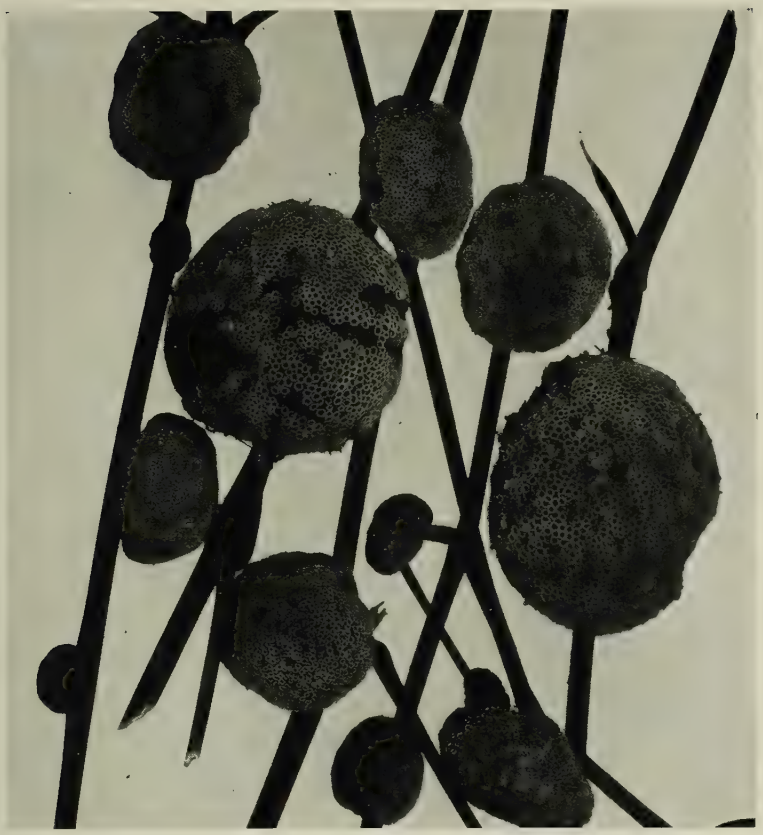

Fig. 7. The cluster-cup or aecial stage of *Puccinia rubigo-vera agropyrina* (Erikss.) Arth. on *Clematis viorna* stems.

served species of Hypoxylon, Diatrype, Xylaria, Daldinia, and Roselinia deserve such attention.

The most useful taxonomic work on the Pyrenomycetes, Ellis and Everhart's *North American Pyrenomycetes,* published in 1892, is now quite inadequate. Many species have been described since its publication. Monographic taxonomic treatises on certain groups, Child (1932), Salmon (1900), Seaver (1910), Theissen and Sydow (1915), and Wehmeyer (1933), have appeared, but the group as a whole must be regarded as largely unknown.

The Discomycetes. Many species of Discomycetes are parasitic, and of the saprophytic species, many are wood-decaying and deserve

special study. The reason for specific choice of substrate by these saprophytes is largely unknown. Studies on the culture of saprophytic members of this group should be considered. Although many disc fungi are known to possess a conidial stage, few of those among our collections possess conidia.

There are two natural groups of disc fungi—the Operculates, monographed by Seaver (1928), and the Inoperculates, monographed by Nannfeldt (1932). The former includes those whose spore sacs open with a lid; and the latter, those lacking a lid.

Fig. 8. The coral-like tooth-fungus, *Manina flagellum* Scop., on decaying log. (Courtesy P. J. Kramer).

THE BASIDIUM FUNGI OR BASIDIOMYCETES

The Basidiomycetes include such groups as are commonly known as smuts, rusts, jelly fungi, leathery fungi, pore or bracket fungi, gill fungi or mushrooms, stinkhorns, puff balls, and bird's nest fungi. They may be divided into two subclasses, the Heterobasidiomycetes or lower Basidiomycetes and Homobasidiomycetes or higher Basidiomycetes. In the former are included the smuts, rusts, and jelly fungi of our list; and in the latter, the remainder of the Basidiomycetes. Many of the Basidiomycetes can be identified by means of the publications of Coker and his colleagues, to which specific reference will be made subsequently. These last publications are invaluable as aids

in identifications for this general region, since many of Coker's collections were made in the region adjacent to the Duke Forest.

The Lower Basidiomycetes. Of the three families of our list, Dacryomycetaceae, Tremellaceae, and Auriculariaceae, the first two, because of their gelatinous consistency, are called the jelly fungi. Many of the species in these families grow only on wood that is in an advanced state of decay, and consequently, they are of no pathological importance. In the family Auriculariaceae, two genera Auricularia and Septobasidium may be worthy of special consideration. Species of Septobasidium are curious fungus-insect combinations occurring on living trees. Their taxonomy and relation to trees has been given consideration by Couch (1935, 1938).

For identification of members of these families, publications by Coker (1920) and Couch (1935, 1938) are recommended.

Identification of smuts is made possible by use of Clinton's taxonomic treatise (1906), of the rusts by Arthur's monograph (1934).

The Higher Basidiomycetes. Structure of the fruiting body, its context, color, shape, and the character of the hymenium, are the bases upon which the higher Basidiomycetes are appropriately classified. So far as forest pathologists are concerned the most important members of this subclass are among the Polyporaceae and Thelephoraceae. Both families contain aggressive pathogens and wood-destroyers.

Clavariaceae. The Clavariaceae or coral-fungi, have their fruit-bodies in the form of coral-like, branched structures. Throughout the summer and fall coral fungi are rather common on the forest floor, and on badly decayed wood. None of them are included in our collections. Except for taxonomic studies almost no work has been done with them, although it is probable that they are important in the decomposition of litter and as mycorrhiza-formers.

For identification of members of this family, Coker's monograph (1923) is recommended.

The Thelephoraceae. The Thelephoraceae or leathery fungi include those Basidiomycetes whose hymenium is membranaceous or leathery and is smooth, lacking pores, gills, or teeth. For the most part the Thelephoraceae of importance to foresters are those which cause decay of felled timber. In this respect they are probably second only to the Polyporaceae. Others may at times be important in producing heartwood rots of living trees which they enter through

Fig. 9. *Peniophora gigantea* (Fr.) Massee on the lower side of pine log. The fruiting bodies, when dry, look like parchment. This fungus causes a destructive decay of pine cordwood.

wounds. In this category are *Stereum gausapatum* Fr., recently shown to involve sprout-growth oaks (Davidson, 1934), *S. frustulosum* (Pers.) Fr., commonly seen on decorticated oak or on oaks that have been scarred by fires, and *S. subpileatum* B. & C. (Long, 1915).

Certain members of the leathery fungi strangle tree seedlings. Two such forms have been noted in this region: *Thelephora albidobrunnea* on seedlings of cedar, black haw, red maple, white oak, white ash, blue beech; and *T. terrestris* on pines.

Smothering disease of seedlings. Smothering disease is caused by *Thelephora terrestris* (Ehrh.) Fr. This fungus is very common and very abundant throughout summer and fall on sites in which the soils are badly eroded. Most commonly it grows apart from the seed plants. It may more or less completely envelop and strangle seedlings and young trees, both coniferous and broad-leaved species. When

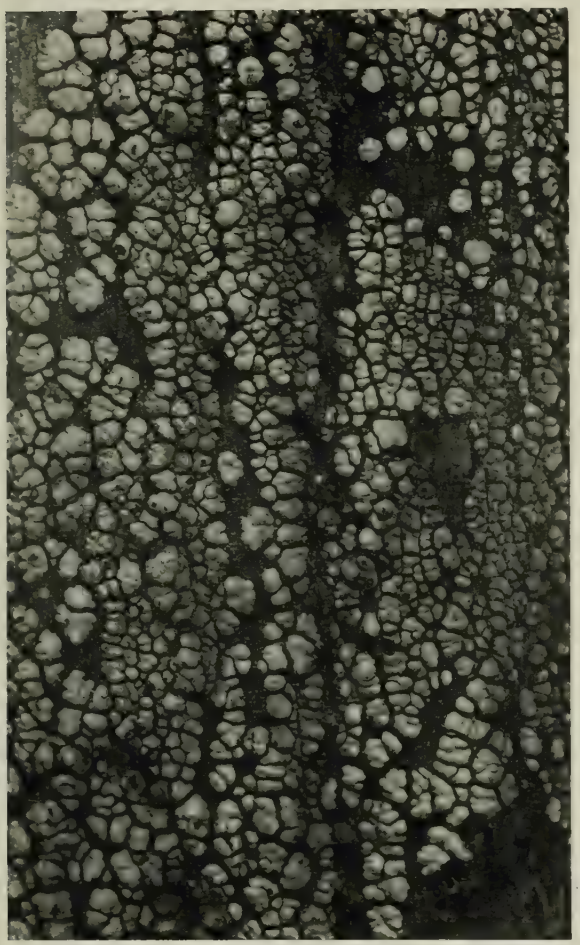

Fig. 10. The cracked crust-like fructifications of *Stereum frustulosum* (Pers.) Fr., the cause of a white pocket rot of oaks.

the fruiting structures or sporophores form on seedlings, they encircle them. They are dark brown, with lighter zones, and are densely hairy. When the sporophores are borne on the soil, they have a central stalk.

Forest pathologists generally agree that this organism is parasitic, as first pointed out by Hartig. Weir (1921) observed that it caused

injury to forest-tree seedlings in British Columbia, Washington, Oregon, Idaho, Montana, Utah, Wyoming, South Dakota, Minnesota, Michigan, and Indiana. He was unable to find that the fungus had invaded any living tissues of pine seedlings, and the nature of its parasitism remains to be studied. Evidently decaying vegetable matter serves as food for *Thelephora terrestris,* and the crowding of seedlings, poor drainage, and high humidity, as may occur in forest nurseries, favor its development.

Decay of felled pine. Attention has recently been directed to a decay of pine logs, caused by *Peniophora gigantea* (Fr.) Massee (Leach, Orr, and Christiansen, 1937). This fungus forms thin, grayish to buff fruit-bodies that are parchment-like when dry. It causes a rapid decay of sapwood and heartwood, and entrance to the heartwood is facilitated by beetle tunnels. With the establishment of pulp mills in the southeastern United States, deterioration of wood, during storage, becomes of enormous economic importance. Ap-

Fig. 11. *Stereum ramale* Schw. on oak. The leathery, zonate, overlapping fruiting bodies densely cover trunks, branches, and twigs.

parently this organism is one of the most potent of our decay-producing species on pine wood.

The Hydnaceae. The Hydnaceae or tooth-fungi include those species whose spore-bearing portion consists of spine-like processes. Only two species are of economic importance in this area. The one, *Manina cordiformis* Scop., better known as *Hydnum erinaceum* Fr., causes a serious heartwood rot of living oak, sycamore, yellow poplar, and black gum within the Duke Forest. The other, *Manina flagellum* Scop. (*Hydnum coralloides* Scop.), causes decay of wood of dead deciduous trees.

The monographic studies by Banker (1909) and Miller (1933, 1934) are widely applicable throughout the United States, while Coker's studies (1919, 1921) deal exclusively with the tooth fungi occurring in this region.

The Polyporaceae. The Polyporaceae or pore fungi include those Basidiomycetes whose hymenium is poroid or tubular, the spores being borne on basidia projecting from the inner walls of the pores or tubes.

To forest pathologists this is probably the most important family of fungi, since most of the organisms producing heartwood rots and sapwood rots of trees and responsible for the decay of wood and lumber, are included within it.

Identification. The Polyporaceae include four subfamilies or tribes, separated as follows:

1. Merulieae: More or less fleshy forms with very shallow tubes which often appear as shallow pits separated by slight ridges or folds.

2. Polyporeae: Fleshy leathery or woody forms with definite tubes, which are firmly united with the main body of the sporophore.

3. Fistulineae: Forms whose consistency is like that of the Polyporeae, but whose tubes are distinct from each other.

4. Boleteae: Fleshy forms, central stalked, with tubes easily separable from the remainder of the sporophore.

The monographic treatment by Burt (1917) will be most serviceable in identification of the Merulieae. For an understanding of the morphological features that may be used in identification of the Polyporaceae the report of investigations by Ames (1913) will be helpful, whereas for taxonomic purposes, in this family, the works of Lowe (1934), Overholts (1914, 1933, and 1935), Shope (1931), Murrill

(1907, 1908), and Baxter (1913, 1927, 1933, 1934, and 1936) may be employed. Identification of Fistulineae and Boleteae is possible by use of the keys by Snell (1936) and Strausee (1930).

Heartwood rotting polypores. The actual economic importance of heartwood rots has been extensively investigated in the West, where it has been found that as high as 30 to 50 percent of the total volume of marketable timber may be reasonably deducted in estimating loss from heartwood rots (Boyce, 1920). Similar studies are lacking in the East, but it is reasonable to expect that the losses are correspondingly high.

The following pore fungi, collected in the Duke Forest, are known causes of heartwood rots of living trees:

Fig. 12. The sapwood rot, *Polyporus ursinus* Lloyd, on pine. The solitary grayish, azonate, fibrillose pilei are 0.5-2.0 by 1.0-4.0 inches. Not common.

Fomes applanatus (Pers.) Gill.
Fomes everhartii (Ell. & Gall.) v. Schrenk.
Fomes fomentarius (L.) Gill.

Fig. 13. Sporophores of *Polyporus versicolor* (L.) Fr., a common cause of decay of deciduous wood. They are leathery, imbricated, velvety and distinctly zonate with many shades of brown. The lower surface is white and poroid.

Fomes igniarius (L.) Gill.
Fomes pini (Thore) Lloyd (*Trametes pini* (Thore) Fr.)
Fomes pomaceus (Pers.) Lloyd
Polyporus berkeleyi Fr.
Polyporus graveolens (Schw.) Fr.
Polyporus hispidus (Bull.) Fr.
Polyporus obtusus Berk.
Polyporus schweinitzii Fr.
Polyporus sulphureus (Bull.) Fr.

The following species have been observed frequently growing on exposed wood of living trees, and their importance as causes of heart-wood rots of living trees should be given consideration.

Daedalea confragosa (Bolt.) Pers.
Daedalea quercina (L.) Fr.
Ganoderma curtisii (Berk.) Murr.
Polyporus gilvus (Schw.) Fr.
Polyporus resinosus (Schrad.) Fr.
Polyporus versicolor (L.) Fr.

Decay of felled timber. All other species of pore fungi collected in this area are more or less commonly associated with decays of felled timber. Since they are so prevalent, they are a constant cause of loss of wood stored in forests, or of standing trees that have been killed by lightning or by other causes. Their study constitutes a fertile field for research. Studies of their general biology and physiology should yield information of value on the complex processes involved in the destruction of wood. Comparative studies of these species should reveal differences between species in manner of attack on wood, in enzymic activity, in influence of moisture and temperature, and in other important features. Such studies should shed new light upon the activities of this important group of saprophytes. Before initiating studies of this nature an investigator should consult the reports of similar studies. References to the more important of these are included herein.

The following list includes the most important species found on decaying wood in this area whose biology should be studied.

Lenzites betulina (L.) Fr.
Merulius incarnatus Schw.
Merulius tremellosus Schrad.
Polyporus abietinus (Dicks.) Fr.
Polyporus adustus (Willd.) Fr.
Polyporus cinnabarinus Fr.
Polyporus cinnamomeus (Jacq.) Fr.
Polyporus frondosus (Dicks.) Fr.
Polyporus hirsutus (Wulf.) Fr.
Polyporus sanguineus (L.) Fr.

Fig. 14. Upper left, *Fomes applanatus* (Pers.) Gill.; upper right, *Fomes igniarius* (L.) Gill.; lower, *Fomes pini* (Thore) Lloyd. *F. applanatus* causes a white butt rot of hardwoods, *F. igniarius*, a white trunk rot, and *F. pini*, red ring rot of conifers.

Polyporus tulipiferus (Schw.) Overh.
Poria ferruginosa (Schrad.) Fr.
Poria versipora Pers.
Trametes heteromorpha (Fr.) Lloyd

Fig. 15. *Fomes applanatus* (Pers.) Gill, a large, woody, sessile, grayish, zonate, bracket fungus. It causes a white butt rot of deciduous trees.

The Agaricaceae. The Agaricaceae, or gill fungi, commonly called mushrooms or toadstools, are quite conspicuous on the forest floor throughout the warmer parts of the year. To foresters a knowledge of the Agaricaceae is important for three reasons. First, certain species, as *Armillaria mellea* (Vahl.) Fr., are aggressive parasites and cause the death of many valuable species of timber trees. Second, certain species are active in the decay of felled timber left in the forest. Of these a great many, typified by *Schizophyllum alneum* (L.) Schrad., *Pleurotus ulmarius* Fr. and *P. ostreatus* Jacq., may attack the wood of living trees exposed through wounds and may cause destructive heartwood rots. Third, many of the gill fungi serve two functions. In the first place, they are largely responsible for the processes which reduce the litter to soluble material. In the second place, the hyphae of these same mushrooms may be associated in many instances in the important mycorrhizal relationships with the trees near which they grow.

Identification. For identification of the genera of Agaricaceae of this area, the keys of Kauffman (1918) and Atkinson (1903) are most useful. For specific determination the keys of Coker (1917, 1918, 1919, 1921, 1922, 1928), Beardslee (1918), and Kauffman (1918) are recommended. Our collections list only a few of the hundreds of species seen in the Duke Forest. Some appreciation of the abundance of the agaric flora of North Carolina can be gained from consultation of the works of Coker, Beardslee, and Hesler (1937).

Important gill fungi. Four of these gill fungi are sufficiently important in this area to deserve special mention.

(a) *Armillaria mellea* (Vahl.) Fr.

This is the common "honey-agaric" or "shoestring-fungus" which has been recognized as an important parasite of deciduous and coniferous forest trees since the days of Robert Hartig. At present it is one of the few gill fungi for which a definite parasitic relationship with the host has been demonstrated. By means of its shoestrings or rhizomorphs this fungus attacks the tree, grows out from old stumps or dead roots, and enters living roots through wounds or dead tissues. The rhizomorphs spread through the cambial region of the roots, and for a short distance through the trunk, eventually causing the death of the tree. The shoestrings may be present in the tree for several years, however, before any outward sign of the disease is evident.

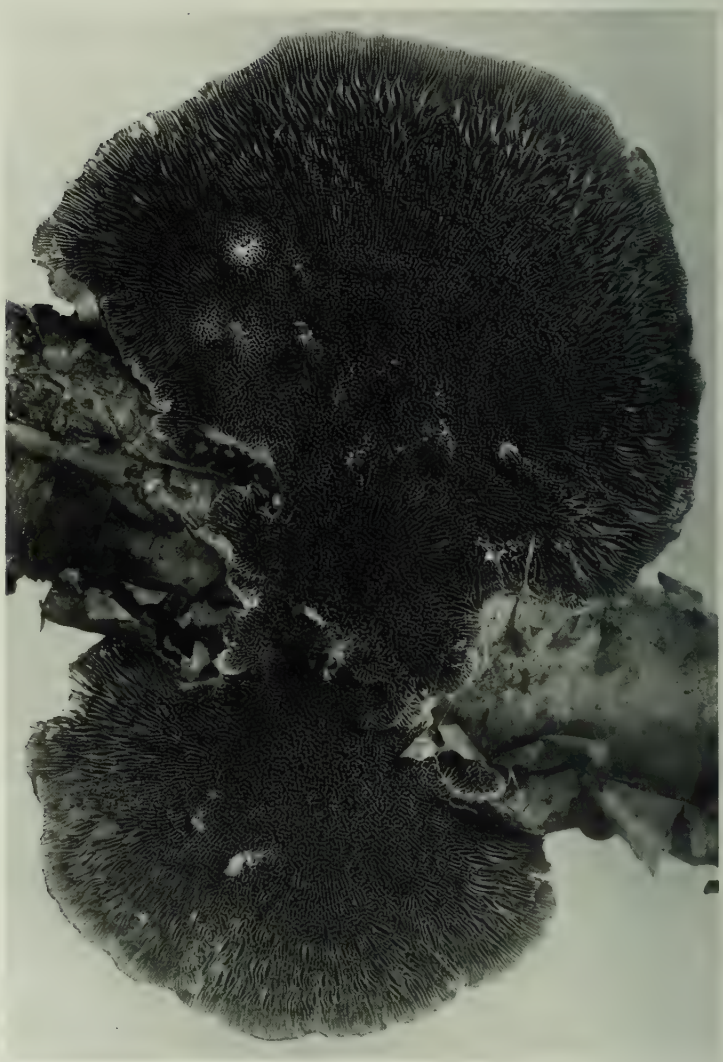

Fig. 16. *Lenzites betulina* (L.) Fr. a leathery, velvety, grayish to brownish zonate, lamellate polypore, of common occurrence on birch. It causes a brown cubical rot.

(b) *Schizophyllum alneum* (L.) Schroet. has been extensively investigated by Putterill (1922). He found the sporophores of this fungus on living trees and, therefore, regarded the fungus as para-

sitic. It would seem that it enters the tree only through wounds or other places in which the wood is exposed, and that it spreads through the heartwood. Sporophores occur on many deciduous forest and orchard trees and have also been observed, frequently, on pine wood in the Duke Forest.

(c) *Pleurotus ostreatus* Jacq. and *P. ulmarius* Bull. have been investigated by Learn (1912). These species enter the heartwood of many deciduous trees through wounds. *P. ostreatus* also attacks the sapwood of standing timber and of logs. Both species are rather frequently observed in this area on oaks, maples, yellow poplars, and willows.

THE IMPERFECT FUNGI OR FUNGI IMPERFECTI

This group includes the conidial or asexual stages of fungi that have been classified artificially. Studies on the development, morphology, and cultural features of many of these imperfect fungi have established their connection with certain Ascomycetes or Basidiomy-

Fig. 17. *Ganoderma curtisii* (Berk.) Murr, common on stumps. The stem is brick red and appears varnished and the upper surface is rusty to grayish.

cetes. No connection is known, however, in the case of the larger proportion of imperfect fungi. Many imperfect fungi are the parasitic phase of important pathogens and as such are worthy of study. Certain genera, notably Cercospora, are represented in this area by a large number of leaf-inhabiting species, some of which are virulent pathogens, whereas other species of Cercospora invade only moribund tissues. Publications like those of Grove (1935, 1937), Lieneman (1929) and Solheim (1929), are valuable for identication of imperfect fungi.

MYCORRHIZAE

In the late 1880's Frank described structures that he designated mycorrhizae, a word whose literal meaning is fungus roots. The

Fig. 18. The trunks and branches of cedar may bear the thin, leathery, buff-colored to brown brackets of *Trametes heteromorpha* (Fr.) Lloyd, a common cause of cubical brown rot of coniferous wood.

term applies to the physiological relationship that exists between the roots of plants, particularly trees, and various fungi. The roots of many crop plants are also similarly involved. The fungi concerned in this relationship are for the most part Basidiomycetes.

Mycorrhizae are now known to be associated with nearly all kinds of trees. Three general types are recognized: ectotrophic, endotrophic, and ectendotrophic. In the first, the fungus forms a mantle over the surface of the young root tips, but the mycelium remains external to the root tissues being therefore extracellular. This type is of common occurrence on the majority of our tree species. In the second, the fungus enters into the cortical cells and is thus intracellular. This type occurs primarily on the members of the heath family and orchid family. In the case of ectendotrophic mycorrhizae, both types of relationships are established by the same fungus.

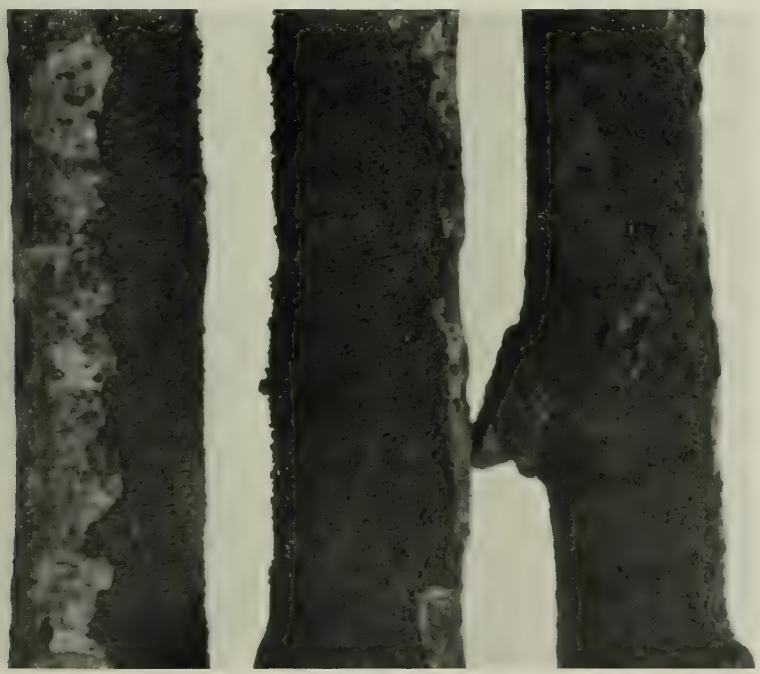

Fig. 19. The sporophores of *Polyporus cinnamomeus* (Jacq.) Fr. are common on the lower side of dead branches of oak. They are leathery, and rusty-brown, and the pore surface is toothed.

Fig. 20. The fly agaric, *Amanita muscaria* Fr., a common poisonous mushroom of the Duke Forest. (Courtesy H. L. Blomquist)

Under ideal conditions the physiological relationships of fungus and host are balanced and relatively stable. If there is a disturbance of equilibrium, however, the fungus may assume a parasitic relation more or less severe. Rayner (1934) regards these unbalanced relations as pseudomycorrhizae. She finds that the incidence of pseudomycorrhizae is associated with soil factors unfavorable for the production of normal mycorrhizae. These soil factors may either inhibit the growth of normal mycorrhizae, or induce a physiological state in the mycelium or in the young rootlets that is unfavorable to the establishment of a normal balanced fungus-host association. Evidence is accumulating to show that certain species of fungi are always associated mutuallistically with certain tree species and stimulate their growth. Unless the fungi are present, the trees do not thrive. Hatch (1936) has shown that certain trees cannot be successfully used in afforestation, unless the appropriate fungus is introduced along with the seedlings or young trees. Perhaps no single pathological problem involving trees has greater significance than mycorrhizae, nor is worthy of more intensive and extensive study.

Investigators would do well to familiarize themselves with the

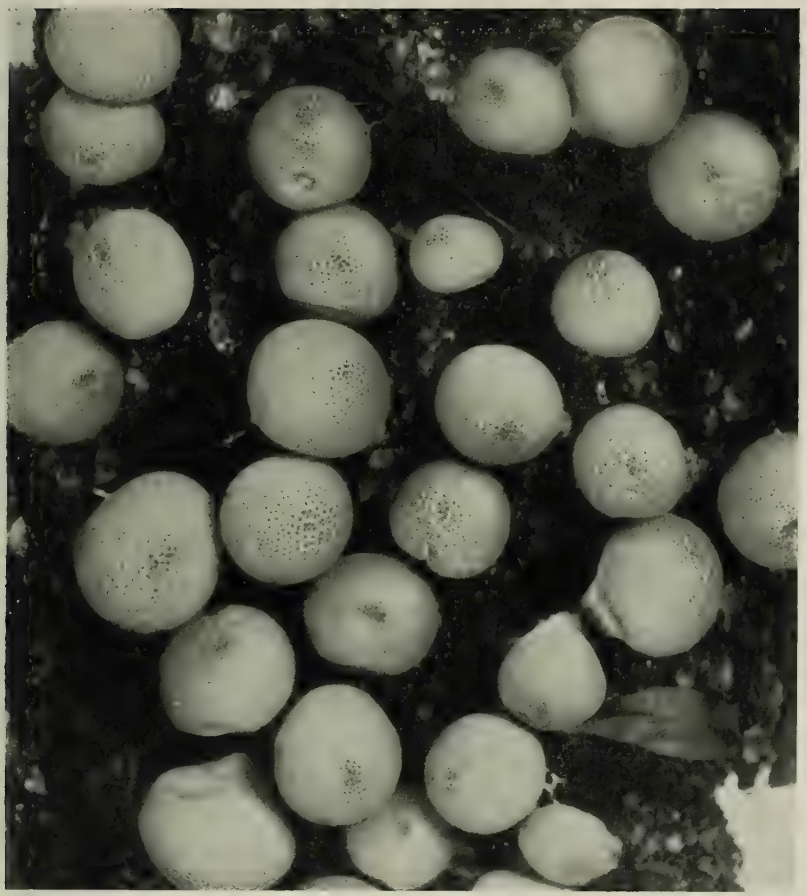

Fig. 21. A common puff-ball, *Lycoperdon pyriforme* Schaeff. It is pear-shaped, white when young, but turns brown with age.

comprehensive studies by Rayner (1922) and Hatch (1937) as a preliminary to undertaking such studies.

REFERENCES

Ames, Adeline. 1913. A consideration of structure in relation to genera of the Polyporaceae. *Ann. Mycol.* **11**: 211-253.

Arthur, J. C. 1934. Manual of the rusts of the United States and Canada. 431 pp. Lafayette, Ind. Purdue Research Foundation.

Atkinson, G. F. 1903. Mushrooms. 322 pp. New York, Henry Holt & Co.

Banker, H. J. 1901. A preliminary contribution to a knowledge of the Hydnaceae. *Bul. Torrey Bot. Club* **28**: 199-222.

———. 1906. A contribution to a revision of the North American Hydnaceae. *Mem. Torrey Bot. Club* **12**: 99-194.

Baxter, D. V. 1925. The biology and pathology of some of the hardwood heart rotting fungi. *Amer. Jour. Bot.* **12**: 522-576.

———. 1929. Some Porias from the region of the Lake States. I. *Mich. Acad Sci. Arts and Letters* **6**: 67-76.

———. 1929. II. *Ibid.* **9**: 39-46.

———. 1932. Some resupinate Polypores from the region of the Great Lakes III. *Mich. Acad. Sci. Arts and Letters* **15**: 191-228.

———. 1933. IV. *Ibid.* **17**: 421-439.

———. 1934. V. *Ibid.* **19**: 305-332.

———. 1936. VI. *Ibid.* **21**: 243-267.

Bayliss, J. S. 1908. The biology of *Polystictus versicolor* Fr. *Jour. Econ. Biol.* **3**: 1-24.

Beardslee, H. C. 1918. The Russulas of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **33**: 147-199.

——— **and W. C. Coker.** 1924. The Mycenas of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **40**: 49-90.

Boyce, J. S. 1920. The dry rot of incense cedar. *U. S. Dept. Agr. Bul.* **871.** 58 pp.

Brown, H. P. 1915. A timber rot accompanying Hymenochaete rubiginosa (Schrad.) Lév. *Mycologia* **7**: 1-20.

Buller, A. H. R. 1906. The biology of *Polyporus squamosus* Huds., a timber destroying fungus. *Jour. Econ. Biol.* **1**: 101-138.

Burt, E. A. 1917. Merulius in North America. *Ann. Mo. Bot. Garden* **4**: 305-362.

———. 1914. The Thelephoraceae of North America. I. Thelephora. *Ann. Mo. Bot. Garden* **1**: 185-228. Pls. 4-5.

———. 1914. II. Craterellus. *Ann. Mo. Bot. Garden* **1**: 327-350. Pls. 15-17.

———. 1914. III. *Craterellus borealis* and Cyphella. *Ann. Mo. Bot. Garden* **1**: 357-382. Pl. 19.

———. 1915. IV. Exobasidium. *Ann. Mo. Bot. Garden* **2**: 627-658. Pl. 21.

———. 1915. V. Tremellodendron, Eichleriella and Sebacina. *Ann. Mo. Bot.* Garden **2**: 731-770. Pls. 26-27. Figs. 1-7.

———. 1916. VI. Hypochnus. *Ann. Mo. Bot. Garden* **3**: 203-241. Figs. 1-30.

———. 1916. VII. Septobasidium. *Ann. Mo. Bot. Garden* **3**: 319-343. Figs. 1-14.

———. 1917. VIII. Coniophora. *Ann. Mo. Bot. Garden* **4**: 237-269. Figs. 1-19.

———. 1918. IX. Aleurodiscus. *Ann. Mo. Bot. Garden* **5**: 177-203. Figs. 1-14.

———. 1918. X. Hymenochaete. *Ann. Mo. Bot. Garden* **5**: 301-372. Pls. 16-17. Figs. 1-32.

———. 1919. XI. Tulasnella, Veluticeps, Mycobonia, Epithele and Lachnocladium. *Ann. Mo. Bot. Garden* **6**: 253-280. Pl. 5. Figs. 1-15.

———. 1920. XII. Stereum. *Ann. Mo. Bot. Garden* **7**: 81-248. Pls. 2-6. Figs. 1-48.

———. 1924. XIII. Cladoderris, Hypolyssus, Cymatella, Skepperia, Cytidia, Solenia, Matruchotia, Microstroma, Protocoronospora, and Asterostroma. *Ann. Mo. Bot. Garden* **11**: 1-36. Pl. 1.

———. 1925. XIV. Peniophora. *Ann. Mo. Bot. Garden* **12**: 213-367.

———. 1926. XV. Corticium and supplement to the whole series. *Ann. Mo. Bot. Garden* **13**: 173-354. 3 figs.

Child, M. 1932. The genus Daldinia. *Ann. Mo. Bot. Garden* **19**: 429-496.

Clements, F. E. and C. L. Shear. 1931. The genera of fungi. IV + 496 pp. New York, H. W. Wilson Company.

Clinton, G. P. 1906. Ustilaginales. *No. Amer. Flora* **7**: 1-82.

Coker, W. C. 1917. The Amanitas of the eastern United States. *Jour. Elisha Mitchell Sci. Soc.* **33**: 1-88.

———. 1918. The Lactarias of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **34**: 1-62.

———. 1919. The Hydnums of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **34**: 163-197.

———. 1919. Craterellus, Cantherellus and related genera in North Carolina with a key to the genera of gill fungi. *Jour. Elisha Mitchell Sci. Soc.* **35**: 24-48.

———. 1920. Notes on the lower Basidiomycetes of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **35**: 113-182.

———. 1920. Notes on the Thelephoraceae of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **36**: 146-196.

———. 1923. The Clavarias of the United States and Canada. 209 pp. Pls. 92. Chapel Hill, N. C., The University of North Carolina Press.

———. 1923. The Saprolegniaceae with notes on other water molds. 201 pp. Pls. 63. Chapel Hill, N. C., The University of North Carolina Press.

———. 1926. Further notes on Hydnums. *Jour. Elisha Mitchell Sci. Soc.* **41**: 270-286.

———. 1928. The Chapel Hill species of the genus Psalliota. *Jour. Elisha Mitchell Sci. Soc.* **44**: 243-256.

——— **and H. C. Beardslee.** 1921. The Collybias of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **37**: 83-107.

——— and ———. 1922. The Laccarias and Clitocybes of North Carolina. *Jour. Elisha Mitchell Sci. Soc.* **38**: 98-126.

——— **and V. D. Matthews.** 1937. Blastocladiales, Monoblepharidales, and Saprolegniales. *No. Amer. Flora* **2**: 1-76.

Couch, J. N. 1935. Septobasidium in the United States. *Jour. Elisha Mitchell Sci. Soc.* **51**: 1-78.

———. 1938. The genus Septobasidium. VII + 480 pp., 114 pls. 60 text figs. Chapel Hill, N. C., The University of North Carolina Press.

Davidson, R. W. 1934. *Stereum gausapatum*, cause of heart rot of oaks. *Phytopath.* **24**: 831-832.

Durand, E. J. 1908. The Geoglossaceae of North America. *Ann. Mycol.* **6**: 387-477.

Ellis, J. B. and B. M. Everhart. 1892. The North American Pyrenomycetes. III + 793 pp. Newfield, N. J.

Engler-Prantl. Die natürlichen Pflanzenfamilien. Leipzig: Wilhelm Engelmann. Teil 1, abt. **1**: 1-513, 1897; Teil 1, abt. **1****: 1-570, 1900.

Essig, F. M. 1922. The morphology, development, and economic aspects of Schizophyllum commune Fries. *Calif. Univ. Pubs., Bot.* **7**: 447-498.

Grove, W. B. 1935, 1937. British stem-and-leaf fungi (Coelomycetes). XX + 406 pp. and IX + 406 pp. Cambridge, University Press.

Hatch, A. B. 1936. The role of mycorrhizae in afforestation. *Jour. Forestry* **34**: 22-29.

———. 1937. The physical basis of mycotrophy in Pinus. *The Black Rock Forest Bul.* **6**. 168 pp., illus.

Heald, F. D. 1926. Manual of Plant Diseases. XIII + 891 pp. New York, McGraw-Hill Book Co. (See pp. 794-805.)

Hedgcock, G. G. 1912. Notes on some diseases of forest trees in our national forests. II. *Phytopath.* **2:** 14-25.

Hesler, L. R. 1937. A preliminary list of the fungi of the Great Smoky Mountains National Park. *Castanea* **2:** 45-58.

Hirt, R. R. 1928. The biology of *Polyporus gilvus* (Schw.) Fr. *N. Y. State Col. Forestry Tech. Pub.* **22.** 47 pp.

———. 1932. The biology of *Trametes suaveolens.* (L.) Fr. *N. Y. State Col. Forestry Tech. Pub.* **37.** 36 pp.

Hubert, E. E. 1931. An outline of forest pathology. VIII + 543 pp. New York, John Wiley and Sons, Inc. (See pp. 353-365.)

Kauffman, C. H. 1918. The Agaricaceae of Michigan. Mich. Geol. and Biol. Surv. Pub. 26. *Biol. Series 5.* **1:** 1-924. **2:** 10 pp. + 172 pls.

Kreiger, L. C. 1936. The mushroom handbook. 538 pp. New York, The Macmillan Company.

Leach, J. G., L. W. Orr, and C. Christiansen. 1937. Further studies on the interrelationship of insects and fungi in the deterioration of felled Norway pine. *Jour. Agr. Research* **55:** 129-140.

Learn, C. D. 1912. Studies on *Pleurotus ostreatus* Jacq. and *Pleurotus ulmarius* Bull. *Ann. Mycol.* **10:** 542-556.

Lieneman, Catherine. 1929. A host index to the North American species of the genus Cercospora. *Ann. Mo. Bot. Garden* **16:** 1-52.

Linder, D. H. 1929. A monograph of the helicosporous Fungi Imperfecti. *Ann. Mo. Bot. Garden* **16:** 227-388. Pls. 12-31. Figs. 1-17.

Long, W. H. 1915. A honey comb heart rot of oaks caused by *Stereum subpilcatum. Jour. Agr. Res.* **5:** 421-428.

Lowe, J. L. 1934. The Polyporaceae of New York State. *N. Y. State Col. Forestry Tech. Pub.* **41.** 142 pp.

McBride, T. H. and G. W. Martin. 1934. The Myxomycetes. X + 339 pp. New York, The Macmillan Company.

Marshall, Nina L. 1905. Mushroom Book. V-XXVII + 170 pp. New York, Doubleday, Page and Co.

Matthews, Velma D. 1931. Studies on the genus Pythium. 136 pp. Pls. 26. Chapel Hill, N. C., The University of North Carolina Press.

Miller, L. W. 1933. The Genera of the Hydnaceae. *Mycologia* **25:** 286-302.

———. 1933. The Hydnaceae of Iowa. I. The genera Grandinia and Oxydontia. *Mycologia* **25:** 356-368.

———. 1934. The Hydnaceae of Iowa. II. The genus Odontia. *Mycologia* **25:** 13-32.

———. 1934. The Hydnaceae of Iowa. III. The genera Radulum, Micronella, Caldesiella and Gloiodon. *Mycologia* **26:** 212-219.

Murrill, W. A. 1907-1908. Polyporaceae. *No. Amer. Flora* **9:** 1-131.

Nannfeldt, J. A. 1932. Studien über die Morphologie und Systematik der nichtlichenisierten inoperculaten Discomyceten. *Nova Acta Reg. Soc. Sci. Upsaliensis.* Ser. **4;** Vol. 8. 353 pp.

Overholts, L. O. 1914. The Polyporaceae of Ohio. *Ann. Mo. Bot. Garden* **1:** 81-155.

———. 1927. A monograph of the genus Pholiota in the United States. *Ann. Mo. Bot. Garden* **14:** 87-210.

———. 1933. The Polyporaceae of Pennsylvania. I. The genus Polyporus. *Penn. Agr. Exp. Sta. Bul.* **298.** 28 pp.

———. 1935. The Polyporaceae of Pennsylvania. II. The genera Cyclomyces, Daedalea, Favolus, Fomes, Lenzites, and Trametes. *Penn. Agr. Expt. Sta. Bul.* **316.** 16 pp.

Percival, W. C. 1934. A contribution to the biology of *Fomes pini* (Thore) Lloyd (*Trametes pini* (Thore) Fries). *New York State Col. Forestry Tech. Pub.* **40.** 72 pp.

Putterill, V. A. 1922. The biology of *Schizophyllum commune* Fries with special reference to its parasitism. *So. Africa Dept. Agr. Sci. Bul.* **25:** 1-35.

Rayner, M. C. 1934. Mycorrhiza in relation to forestry. *Forestry* **8:** 96-123.

———. 1922. Mycorrhiza. 246 pp. London, Wheldon and Wesley, Ltd.

Rhoads, A. S. 1918. The biology of *Polyporus pargamenus* Fries. *N. Y. Sta. Col. Forestry Tech. Pub.* **11.** 197 pp.

Salmon, E. S. 1900. A monograph of the Erysiphaceae. *Mem. Torrey Bot. Club* **9:** 1-292.

Saccardo, P. A. Sylloge Fungorum omnium hucusque cognitorum. Vols. 1-25. Pavia, Italy.

Schrenk, H. von and P. Spaulding. 1909. Diseases of deciduous trees. *U. S. Dept. Agr., Bur. Plant Ind. Bul.* **149.** 85 pp.

Seaver, F. J. 1910. Hypocreales. *No. Amer. Flora* **3:** 1-56.

———. 1922. Phyllostictales. Phyllostictaceae. *No. Amer. Flora* **6:** 1-84.

———. 1928. The North American Cup Fungi. 284 pp. New York.

Seymour, A. B. 1929. Host index of the fungi of North America. XIII + 732 pp. Cambridge, Mass., Harvard University Press.

Shope, P. F. 1931. The Polyporaceae of Colorado. *Ann. Mo. Bot. Garden* **18:** 287-456.

Snell, W. H. 1936. Tentative keys to the Boletaceae of the United States and Canada. *Rhode Island Bot. Club Bul.* **1.** 25 pp.

Solheim, W. G. 1929. Morphological studies of the genus Cercospora. *Ill. Biol. Monographs* **12:** 1-84. Pls. 1-4.

Spaulding, P. 1905. A disease of black oaks caused by *Polyporus obtusus* Berk. *Mo. Bot. Garden Rept.* **16:** 109-116.

———. 1911. A timber rot caused by *Lenzites sepiaria. U. S. Dept. Agr., Bur. Plant Ind. Bul.* **214.** 37 pp.

Strausee, M. C. 1930. The Boletaceae of Pennsylvania (including Fistulineae). *Proc. Penn. Acad. Sci.* **4:** 17-24.

Theissen, F. and H. Sydow. 1915. Die Dothidiales. *Ann. Mycol.* **13:** 149-746.

Thomas, H. E. 1934. Studies on *Armillaria mellea* (Vahl.) Quel., infection, parasitism, and host resistance. *Jour. Agr. Research* **48:** 187-218.

Wehmeyer, L. E. 1933. The genus Diaporthe Nitschke and its segregates. *Univ. of Mich. Sci. Ser.* **9:** I-X + 349 pp., illus.

Weir, J. R. 1913. Some observations on Polyporus berkeleyi. *Phytopath.* **3:** 101-103.

———. 1921. *Thelephora terrestris, T. fimbriata* and *T. caryophyllea* on forest tree seedlings. *Phytopath.* **11:** 141-144.

White, E. A. 1905. A preliminary report on the Hymeniales of Connecticut. *Conn. State Geol. and Nat. Hist. Surv. Bul.* **3.** 81 pp.

White, J. H. 1919. On the biology of *Fomes applanatus* (Pers.) Wallr. *Roy. Canadian Inst. Trans.* **12:** 133-174.

Zeller, S. M. 1916. *Lenzites sepiaria* Fr. with special reference to enzyme activity. *Ann. Mo. Bot. Garden* **3:** 437-512.

———. 1917. Physical properties of wood in relation to decay induced by *Lenzites sepiaria* Fr. *Ann. Mo. Bot. Garden* **4:** 93-164.

THE MORE IMPORTANT FUNGI CAUSING TREE DISEASES AND DECAYS IN THE DUKE FOREST

The purpose of this chapter is to indicate the more important problems in forest pathology that have been encountered in the making of this survey. The primary basis for opinions as to the relative importance of the various organisms affecting the different species of trees has been the destructiveness of the pathogen or the abundance of the disease. These criteria may not constitute an entirely satisfactory basis for judgment, since different observers might not evaluate the conditions similarly. The accounts that follow have been arranged according to the common name of the different tree species. In each case the materials presented and references given should serve to introduce the investigator to the disease or to the associated organism, and to indicate what seems the most desirable course to be pursued in further studies.

ALDER

DIE-BACK.—The most destructive disease of alder, *Alnus rugosa* (DuRoi) Spreng., in this region appears to be caused by one of the leathery fungi, *Solenia anomala* (Pers.) Fkl. The branches alone or the entire plant may be involved, and throughout autumn the dead parts are beset with the fruiting bodies. In dry weather these fruiting bodies are brown, club-shaped, hairy structures about one-eighth inch long. In moist weather they expand with a disc-like grayish top. This organism in its biologic and parasitic relationship appears never to have been studied.

ASHES

LEAF BLIGHT.—Apparently the most important disease of ashes, *Fraxinus americana* L. and *F. pennsylvanica* Marsh, in the area covered by this report, is one that involves the foliage. It begins to appear by the time that the leaves have attained their mature size. Attention is attracted to the disease by the blighted appearance of the trees, by the profusion of fallen leaflets, and by the fact that defoliation continues throughout spring for a period of about two months. Large, irregular, brown lesions are formed, and, in consequence, the leaves are curled and deformed. Microscopic examination reveals that the causal organism is *Gloeosporium aridum* E. & H., first briefly described in 1887 (Ellis and Everhart). In nutrient

Fig. 22. Alder branches bearing the brown fructifications of *Solenia anomala* (Pers.) Fckl.

agar this fungus forms a sparse mycelium which is soon obscured by the abundance of conidia, that bud in a yeast-like fashion. The resultant growth has the appearance of bacterial colonies. Detailed

Fig. 23. Ash leaf spot caused by *Phyllosticta viridis* Ell. & Kellerm. The lower surface of the indefinitely bordered lesions is occupied by numerous black pin-point-like pycnidia.

knowledge of the organism and of the disease are wholly wanting. The life cycle of the pathogen should be studied. Probably it survives from one season to the next by means of conidia that lodge between the bud scales and remain dormant until the buds open.

LEAF SPOT.—After midsummer ashes may be affected with a leaf spot disease that is manifest by the presence of indefinite yellowish-brown lesions 1 cm. or more across. The margins of the spots gradually merge into the surrounding apparently normal tissues. By fusion of lesions the entire leaf surface may be involved, and by early fall the entire foliage may be affected. Numerous scattered pycnidia occur on the lower leaf surface. These have been identified as belonging to *Phyllosticta viridis* Ell. & Kellerm. Diseased leaves that have remained on the ground throughout winter are occupied by a species of Mycosphaerella, as yet unidentified, that may prove to be the perfect stage of this Phyllosticta. Studies of this disease and of the life history of the pathogen are in progress.

BEECH

BLACK SPONGE.—The twigs of beech, *Fagus grandifolia* Ehrh. and less commonly alder twigs, *Alnus rugosa* (DuRoi) Spreng., may be found invested with conspicuous black lumps several inches in dimensions. These growths are hard, brittle, and carbonaceous when dry; but when wet with rain or on being placed in water, they quickly soften and become sponge-like. Each black mass constitutes the vegetative and fruiting structures of one of the sooty molds, *Scorias spongiosa* (Schw.) Fr. This organism subsists upon woolly aphids, that commonly infest beech and alder, and it is not parasitic upon the trees themselves. It is, therefore, the cause of no direct injury to beeches or alders. Its life history and development have not been investigated, and the organism awaits mycological consideration.

DECAY OF BRANCHES.—Occasionally the smaller limbs on the trees or branches that have fallen are found to be invaded by the fungus, *Endothia gyrosa* (Schw.) Fr. It forms red stromatic pustules that break through the bark, and that are macroscopically identical with those of the well-known chestnut blight fungus. This organism also occurs upon the roots of red gum and of various species of oak. It is of interest and might be worthy of study because of its generic relationship to the chestnut blight fungus, *Endothia parasitica* (Murr.) Anders.

BUCKEYE

LEAF BLOTCH.—The foliage of common buckeye, *Aesculus neglecta* Lindley, in this area, is universally affected by a leaf blotch disease. It appears about midsummer, and can be recognized by the dark red or brownish lesions that involve large, irregular areas. A yellowish border occurs along the margin of the dead, dry tissues. Minute black specks, the conidial stage of the pathogen, are scattered within the dry tissues. By mid-August the trees in this area are practically defoliated. This disease involves other species of Aesculus, especially horse chestnut, *A. hippocastaneum* L., and the Ohio buckeye, *A. glabra* Willdenow, in the northeastern United States, and it is known also in Europe.

Leaf blotch is caused by *Guignardia aesculi* (Pk.) Stewart (1916). Its conidial stage, called *Phyllosticta paviae* Desm., is present in summer. During fall the perithecial stage begins to be formed and it continues to develop on the fallen leaves. By March or April it

Fig. 24. Branch of beech, through whose bark red stromata of *Endothia gyrosa* Fr. protrude.

is mature. Then ascospores may be discharged, and, as a result, young leaves may soon become infected.

If it should become necessary to control this disease, the destruction of fallen infected leaves would appear to be the logical procedure.

CEDAR

ROOT AND BUTT ROT.—The most destructive disease of cedar, *Juniperus virginiana* L., in this area, is root and butt rot. This disease will escape notice until the leaves over the entire tree rather suddenly become dry, unless special attention is given to the state of vigor of the trees. Trees of all ages, from those less than a foot tall to those one hundred or more years old, are subject to the disease. The dry scale leaves remain for a time on recently killed trees, but trees dead more than a season are stark and bare. The roots become decayed to the extent that affected trees are easily subject to wind throw. The decay is confined to the basal part of the trunk. Paper-like layers of white mycelium occur within the outer bark.

The sporophores appear in late fall and winter and, except in rare cases, are first evident only after the trees are dead. They are either bracket-shaped or consist of irregular, imbricated layers formed at or near the surface of the soil, especially if there is an abundance of leaf mold at the base of the tree. Leaves, twigs, and stones are usually incorporated within the sporophores. They are grayish-brown above and yellowish-white below. The sporophores might easily be regarded as those of some species of Polyporus. During the second season after the trees have been killed, however, the perennial nature of the sporophores becomes evident. Sometimes they are completely destroyed by insects during the first season.

Cedar root rot or butt rot is caused by *Fomes annosus* Fr. This organism is known to be among the most destructive of all occurring on conifers in Europe. Although nearly all conifers are listed as suscepts, it is most common on fir, hemlock, spruce, Douglas fir, and white pine. It is known to parasitize several species of broad-leaved trees, but apparently is of little economic importance on them.

A thoroughgoing study of this organism in its relationship to cedar should be made. Pathogenicity of *Fomes annosus* seems never to have been proved. Among the features upon which information should be sought are: effect of site upon incidence of the disease, under what conditions infection is accomplished, how the pathogen is disseminated, the function of the Oedocephalum or conidial stage, and what are the food relationships of the fungus.

RUSTS.—Acquaintance with the taxonomy of cedar rusts can best be made by consulting Kern's treatise (1911). Four important species of rusts, belonging to the genus Gymnosporangium, have been found on cedar in the Duke Forest. All are very conspicuous in

Fig. 25. Lower surface of a sporophore of *Fomes annosus* (Fr.) Cke. from the base of a dead cedar tree. About 6 x 12 inches in dimensions.

Fig. 26. Upper surface of sporophore of *Fomes annosus* (Fr.) Cke. Debris and stones are included within the sporophore.

spring, especially after rains, at which times they are characterized by glistening, orange-colored, jellylike masses on the leaves, twigs, branches, or trunk. In dry weather they are scarcely noticed. Each of these rusts has its alternate stage on one or more of the species of Rosaceae, including apple, pear, crabapple, hawthorn, and serviceberry.

Of the four species of Gymnosporangium in this area, two form brown galls, varying in diameter from about one-sixteenth inch to two inches. These are known as "cedar apples" or "cedar balls." Hornlike projections, an inch or more long, that are jellylike, arise from these galls in wet weather. The projections of the one, *Gymnosporangium juniperi-virgininae* Schw., are tubular but are circular in diameter; whereas those of the other, *G. globosum* Farl., are flattened or tongue-like processes. *Gymnosporangium clavipes* C. & P., the most noticeable of these four species, produces perennial swellings on the trunk, branches, and twigs, and the jellylike masses of spores ooze from cracks in the bark. *G. nidus avis* Thax. causes the formation of witches' brooms, rosette-like arrangements of the branches.

All species of Gymnosporangium retard the growth of cedar or cause more or less deformation.

Studies comparable to those of Crowell (1934) on *G. juniperi-virginiae* or of MacLachlan (1935) on *G. globosum* should be conducted on *G. clavipes* and *G. nidus avis*. In the light of studies on the perennial rust, *Kunkelia nitens* (Schw.) Arth. on brambles (Pady, 1934), anatomical studies of *G. clavipes* and *G. nidus avis* should be undertaken to determine the parasite-host relations, especially whether these rusts possess intra- or inter-cellular mycelium.

LEAF SPOT.—The presence of this disease may be suspected if the cedars show a marked lack of vigor. Examination with a hand lens may reveal one to a few black structures on each of the moribund scale leaves. These are the fruiting structures of the disc fungus, *Keithia juniperi* Miller (1935), that causes leaf spot.

This disease was first described recently from the Duke Forest, and its geographic range is unknown. Whether it is responsible for appreciable damage here and in other areas where cedar is grown should be determined by surveys. The causal organism is of interest to mycologists for the reason that of the five species of Keithia that are known, two are two-spored, two are four-spored, whereas *K. juniperi* is eight-spored. All species are restricted to conifers.

Fig. 27. The cedar-apple rust, *Gymnosporangium juniperi-virginianae* Schw. as it appears, in spring, following rain. (Courtesy W. C. Coker).

Fig. 28. The witches' broom rust, *Gymnosporangium nidus-avis* Thax. on cedar. (Courtesy W. C. Coker).

CHERRIES

LEAF BLISTER OR LEAF CURL.—Species of fungi belonging to the genus Taphrina cause a swollen, wrinkled, blistered appearance of the leaves of various plants in early spring. Often these blistered areas are yellowish or reddish; and when the disease is abundant, marked defoliation occurs. Diseases of this type are common on trees and shrubs that bear their flowers in catkins, as the oaks, birches, poplars, alders, and hop-hornbeams. In this area plums, peaches, and cherries are also subject to leaf curl diseases. The most common one on black cherry, *Prunus serotina* Ehrh., is *Taphrina varius* Atk. It is closely related to *T. deformans* (Beck) Tul., oc-

curring on peach. Other species of Taphrina, common in this vicinity, are *T. caerulescens* (Mont. & Desm.) Tul. on oaks, *T. mirabilis* (Atk.) Giesenh. on plums, and *T. purpurascens* (E. & E.) Robinson on sumac. Comparative life history and cultural studies should be made of all of these species.

SHOT HOLE.—In midsummer, black cherries are commonly attacked by a fungus that causes the formation of reddish to purplish lesions on the leaves. In humid weather the surface of these lesions is covered with whitish to pinkish masses. If the masses are examined microscopically they are found to consist of thread-like elements, the conidia of *Cylindrosporium lutescens* Higgins. The discomycetous stage, *Coccomyces lutescens* Higgins, occurs in spring on fallen decaying leaves. This disease may result in serious defoliation.

Fig. 29. At left, black knot, *Plowrightia morbosa* (Schw.) Sacc. on bird cherry; Middle, *Hypoxylon fuscum* (Pers.) Fr. on alder branch; at right, *Penzigia frustulosa* (B. & C.) Mill. on oak branch.

BLACK KNOT.—The most conspicuous disorder of bird cherry, *Prunus avium* L., is black knot, caused by *Plowrightia morbosa* (Schw.) Sacc. The knots may be so numerous that several hundred occur on a single tree. As the name indicates, large black knots occur on the twigs and larger branches. These knots are an inch or more long, and their diameter is several times that of the twig on which they form. The portion distal to the knot usually dies, and infected trees are dwarfed and distorted. Reciprocal cross inoculations should be made with the black knot fungus from cherries and plums, and their life histories should be elucidated, in accordance with a series of studies by Koch (1933, 1935).

ELMS

ELM LEAF SCAB.—The most conspicuous leaf disease encountered in this area is leaf scab, caused by *Gnomonia ulmea* (Schw.) Thüm. It appears throughout summer and fall as irregular grayish patches formed abundantly upon the upper leaf surface. Black pustules protrude from these lesions. Considerable premature defoliation results. *Gloeosporium ulmeum* (Schw.) Miles is said to constitute the conidial stage. Much of our knowledge of this disease comes from the studies of Miles (1921).

Since the disease is so widely prevalent in the eastern United States, further study of it should be valuable. Special consideration should be given to hibernation of the pathogen, conditions favoring infection, and to an elucidation of its cycle of development and of its morphology, especially in comparison with previously studied pathogenic species of Gnomonia. Careful comparison should also be made with *Dothidella ulmea* (Schw.) E. & E., with which it has been confused.

TWIG ROT.—The limbs and twigs of elms, injured by shading or other causes, generally become invaded by one of the polypores. This polypore forms its fruiting structures at the surface, where they appear as thin, papery, white to gray, concentrically zonate, nest-like or conch-like cups or brackets. The fungus is known as *Polyporus conchifer* (Schw.) Fr., and its biology remains largely unknown.

SLIME FLUX.—Occasional trees are encountered that exhibit a chronic exudation of fluid, usually flowing from wounds or fissures. This exudate may have odors of fermentation or putrefaction. Various species of bacteria, yeasts, and yeast-like organisms have been found to occur in the ooze. In this region, slime flux not only of

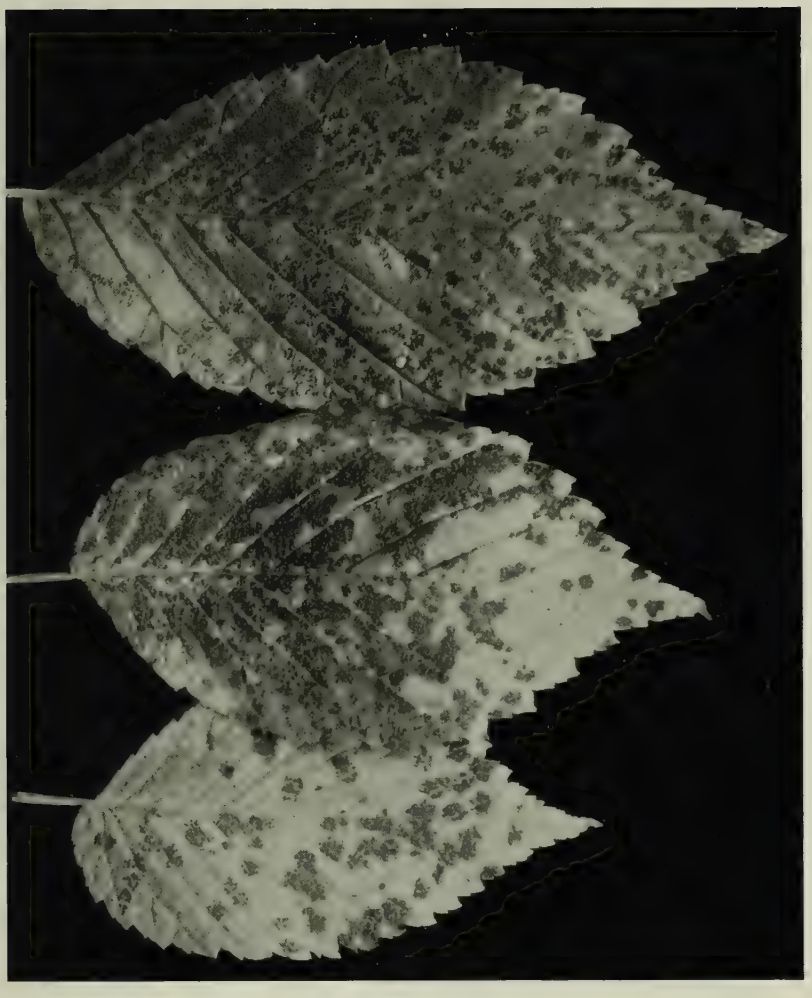

Fig. 30. Scab caused by *Gnomonia ulmea* (Schw.) Thüm. on leaves of white elm. The leaves lose their color and shiny, black stromata project from the upper leaf surface.

elms, but of oaks, and yellow poplars remains to be intensively studied, as well as its possible relationship to a condition known to foresters as "wet wood." Before undertaking research on slime flux diseases one would do well to consult a publication by Stautz (1931).

Fig. 31. A pore fungus, *Polyporus conchifer* (Schw.) Fr., of common occurrence on elm. The brackets are white, smooth, and zonate.

WHITE PUSTULE SPOT.—By late August or early September winged elm, *Ulmus alata* Michx. and *U. fulva* Michx., in this area, may be defoliated by *Mycosphaerella ulmi* Kleb. This disease can be recognized by the numerous, pale-yellowish spots evident from the upper leaf surface, and the whitish pustular outgrowths upon the lower leaf surface. These pustules, as seen with a hand lens, resemble the cluster-cups of rusts. They are in reality the widely opened

pycnidia of *Phleospora ulmi* (Fr.) Wallr., the conidial stage of the pathogen. The perithecial stage is mature by spring on decaying leaves. It has been found in abundance in the Duke Forest. Even though genetic connection of perithecial and conidial stages was established long ago by Klebahn (1905), a detailed morphological and developmental study of this organism is desirable.

Fig. 32. *Daedalea confragosa* (Bolt.) Fr., a widely prevalent cause of white mottled rot of deciduous wood, on branch of sweet gum. The pilei are leathery, sessile, grayish to light brown, and the pore surface is lamellate.

POWDERY MILDEWS.—In early autumn the leaves of winged elms may assume a white, mealy appearance due to one or the other of several species of powdery mildews. The species collected on this host include *Phyllactinia corylea* (Pers.) Karst., usually on the upper leaf surface, and *Uncinula intermedia* B. & C. and *U. macrospora* Pk., on the lower leaf surface. The latter two may eventually be found to be identical. None of these can be identified with certainty except with the aid of a microscope.

RED OR SWEET GUM

RED LEAF SPOT.—The foliage of red gum, *Liquidambar styraciflua* L., remains remarkably free from serious diseases in this area. One of the minor diseases that has been encountered manifests itself by the presence of small reddish-margined lesions whose central tissues are necrotic. Lesions may also extend along the veins, thus simulating the appearance of sycamore anthracnose. The organism concerned has been identified as *Leptothyriella liquidambaris* Tehon & Stout. It would seem better, however, to allocate it in the closely related genus Pirostoma. Whether this change should be made will be determined only after a thoroughgoing developmental study.

CERCOSPORA LEAF SPOT.—Young trees are especially subject to a leaf spot disease that may be recognized by the presence of numerous pin-head sized, dark brown spots whose margins are bordered by indefinitely limited wine-colored areas. Several hundred lesions are commonly present on a single leaf, in which event the entire upper surface becomes wine-colored by midsummer. This discoloration is less pronounced on the lower leaf surface.

The causal organism is *Cercospora liquidambaris* Cke. & Ell. A brief mycological description, together with notes on collection of specimens, constitutes all that has been published regarding the disease. A developmental study of this disease and of its causal fungus should be made. Undoubtedly a perithecial stage would be found to occur on affected decaying leaves.

TWIG DECAY AND WOOD ROT.—The fallen branches and cut wood of red gum are almost always attacked by *Daedalea confragosa* (Bolt.) Pers. Although this polypore causes decay of many other kinds of wood, few wood-destroying fungi of other species are found on red gum. The reasons why the common wood-rotting fungi do not readily attack this tree species are unknown. It should be profitable to study the biology of this organism in an attempt to learn the reason why red gum wood is so commonly destroyed by it.

HICKORIES

WHITE SPOT.—The foliage of hickories within the Duke Forest is remarkably free from fungous diseases. A disease of minor importance, caused by *Microstroma juglandis* (Bereng.) Sacc., is most common. It appears in spring when the leaves are approximately of mature size, and is characterized by the presence of a white, powdery coating on the lower leaf surface that resembles a powdery

mildew. Pale green, angular areas are evident from the upper surface, and eventually dry brown patches constitute the invaded tissues.

The systematic position of Microstroma remains unsettled. It was first described in 1847, and placed among the *Fungi Imperfecti.* Several early mycologists, however, placed it among the Basidiomycetes, near Exobasidium. Recent studies by Wolf (1929) indicate that it is one of the imperfect fungi as judged by the observation that (1) the conidiophores are polynuclear, (2) the nuclei occur within conidiophores bearing a crown of spores, (3) the conidiophores in the same fascicle are uneven-aged, (4) the spores are symmetrical and are attached to sterigmata by a central basal hilum, (5) the clamp connections are absent, (6) conjugate nuclei were not observed. Evidence of basidiomycetous relationship is presented by Pires (1928) mainly on the basis of (1) clavate basidia, bearing sterigmata, constant in number on which spores are produced singly, (2) clamp connections between mycelial cells, and (3) binucleate mycelial cells. A study of the life history of this organism should be made as a basis for determining its true systematic position.

HOLLIES

BLACK SPOT.—The American holly, *Ilex opaca* Ait., in this area, is not subject to any fungous disease of major importance. Occasional trees may be noted, however, whose leaves have the appearance of being affected with a tar spot disease. In spring small, shiny, black blotches are formed on the upper surface of old leaves. In wet weather the centers of these blotches become irregularly fissured, exposing reddish cup-like structures, fringed by upturned epidermal tissues of the leaf. These structures constitute the fruiting bodies of the causal organism, and have the appearance of those of the phacidiaceous fungi. Whether the organism is *Phacidium elegantissimum* B. & C. or *Rhytisma curtisii* B. & Rav. or whether these names apply to one and the same organism is unknown. Von Höhnel (1917) made *R. curtisii* the type of the genus Macroderma in the Dermopeltineae. Nannfeldt (1932) believes that a comparative study should be made of *Macroderma curtisii* and members of the genus Phacidium as a basis for determining its true systematic position.

TAR SPOT.—The foliage of deciduous holly, *Ilex decidua* Walt., is commonly affected with a tar spot disease, *Rhytisma ilicinicola* (Schw.) Fr. Since so-called tar spot diseases of honey locust (1936) and of high-bush blueberry, *Vaccinium arboreum* Marsh (1934), have

Fig. 33. Black spot on leaves of American holly. When the black fruiting bodies of the causal fungus, *Macroderma curtisii* (B. & Rav.) Höhn. open their inner surface is pinkish.

recently been found to be caused by pathogens wholly unrelated to *Rhytisma acerinum* (Pers.) Fr., the cause of tar spot on maples (1925), a mycological and pathological study of the tar spot disease of deciduous holly should be made. This study might well constitute a portion of a comparative study of all tar spot diseases occurring on woody plants in this area.

HONEY LOCUST

TAR SPOT.—The foliage of honey locust, *Gleditsia triacanthos* L., in late summer, is commonly infected by an organism recently described (1935) as *Linospora gleditsiae* Miller and Wolf. The disease can be recognized by the presence of very numerous black specks about the size of pin-heads, occurring on the lower leaf surface. Each tar-like speck is the fruiting body, the conidial stage of the pathogen.

Fig. 34. *Linospora gleditsiae* Miller & Wolf, in its conidial stage, on honey locust. The lower leaf surface is densely beset with black specks.

This stage has long been known as *Melasmia hypophylla* (B. & Rav.) Sacc., because of its resemblance to the well-known organism producing tar spot diseases on maples and willows, caused however by other species of Melasmia. The infected leaflets of honey locust are shed prematurely and abundantly. After the leaves have remained on the ground until late spring of the following year, the perithecial stage is matured and shortly thereafter the new foliage becomes infected. No information is available regarding the damage caused by this disease. Apparently it does not kill the trees but merely retards their growth.

BLACK LOCUST

POWDERY MILDEW.—The seedlings of black locust, *Robinia pseudoacacia* L., have been noted to be affected by one of the powdery

mildews that has been identified as *Microsphaera diffusa* C. & P. Apparently this report constitutes the first record of this type of pathogen on black locust. For this reason it would be of interest to make a comparative study of *Microsphaera diffusa* on stick-tight and other leguminous suscepts with the organism on black locust.

MAPLES

TAR SPOT.—Tar spot, as the name implies, characterizes an infection of maples, in which raised, shiny, tar-like blotches, approximately one-quarter inch in diameter, appear on the foliage. This disease is prevalent in late summer on red maple and causes leaf cast.

Tar spot is caused by *Rhytisma acerinum* (Pers.) Fr. A detailed knowledge of this organism may be gained from a report of studies by Jones (1925). The tar spot pathogen possesses a conidial stage, *Melasmia acerina* Lév., prevalent during summer. In autumn spermogonia and archicarps, the precursors of the apothecia, form within the conidial stromata. By the following spring the apothecia will have matured within the tissues of the fallen leaves.

GRAY SPOT.—The foliage of introduced silver maples, *Acer saccharinum* L., is subject to a disease of minor economic importance that can be recognized by the presence of grayish to tan spots in whose tissues are immersed black pin-point-like dots. The spots may fuse, and the dead tissues fall away, after which the leaves look frayed and torn. Nothing is known of this disease except the identity of the causal fungus. It is a conidial fungus, *Phyllostictina minima* (B. & C.) Underw. & Earle. Since several species of this genus are known to possess a perithecial stage belonging to the genus Guignardia, it is probable, if a study of its life history were made, that the maple leaf spot organism would be found to be a species of Guignardia.

ANTHRACNOSE.—Sugar maples, *Acer floridanum* (Chapm.) Max. and *A. saccharum* L., planted as shade and ornamental trees in this region are in some cases severely defoliated by one of the anthracnose fungi, *Gloeosporium apocryptum* E. & E. The disease can be recognized by a blighting of the foliage, resembling somewhat the symptoms exhibited by the well-known sycamore blight. Large irregular lesions involve the leaf margins and the tissues most distant from the veins. A comprehensive study of this disease and of its causal organism should be made.

MULBERRY

LEAF SPOTS.—Two diseases, recently studied, involve the foliage of red mulberry within the Duke Forest. One causes the formation of circular, brown spots with dark brown borders. The lower surface of these lesions may be encrusted with a pinkish film of conidia. This disease is caused by the conidial stage of *Mycosphaerella mori* (Fckl.) Wolf (1935).

Fig. 35. Lesions on red mulberry foliage produced by the conidial stage of *Mycosphaerella mori* (Fckl.) Wolf.

The other disease has the appearance of a mildew in that the lower leaf surface is effusely covered by a white mealy coating. This coating is constituted of the external hyphae and the profusion of conidia of the pathogen. Necrotic lesions appear before the leaves fall, and in spring the decaying leaves are occupied by the perithecial stage, *Mycosphaerella arachnoidea* Wolf (1936).

OAKS

OAK LEAF CURL OR LEAF BLISTER.—Several of the species of oaks, in this region, notably blackjack oak, *Quercus marilandica* Muench,

Fig. 36. Mildew-like growth on leaves of red mulberry, the conidial stage of *Mycosphaerella arachnoidea* Wolf.

post oak, *Q. stellata* Wang., red oak, *Q. rubra* L., swamp red oak, *Q. rubra* var. *pagodaefolia* (Ell.) Ashe, and black oak, *Q. velutina* Lam., are commonly affected with the leaf-curl disease. It may be recognized by the presence of blisters and wrinkles on the leaves during late spring and early summer. The surface of the blisters is pale green to grayish when the causal fungus is fruiting. Later the affected tissues become dry; and large irregu'ar, dead areas, extending beyond the invaded tissues, are formed. Usually little serious damage is done. In severe cases the foliage is rendered un-

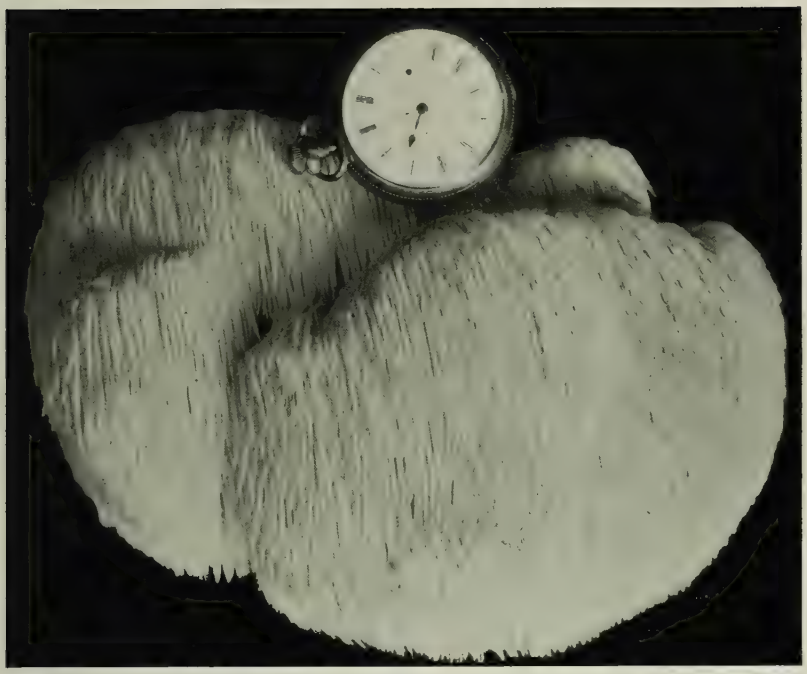

Fig. 37. The snowy-white tooth fungus, *Manina cordiformis* Scop., the cause of a heart rot of oaks, sycamore, and black gum in the Duke Forest.

sightly, much of the tissue being killed, and appreciable defoliation ensues.

No comprehensive study of this disease has been made. The host range should be determined, especially the apparent immunity of willow oak and water oak in some areas. The causal fungus *Taphrina caerulescens* (Mont. & Diet.) Tul. is presumed to hibernate on the surfaces of the bud scales, as has been established to be the case with *T. deformans* (Beck.) Tul. on peach. If researches similar to those conducted by Mix (1935), Martin (1924, 1925, 1936), and Fitzpatrick (1934) with related species of Taphrina, could be made with the oak leaf curl, they would constitute a valuable addition to our knowledge.

Purple Blotch.—In late summer indefinitely limited discolored areas appear upon the leaves on black oaks, *Quercus velutina* Lam. and red oaks, *Q. borealis* Michx. Near the centers of these discolored areas are elongate black objects, scarcely perceptible except with the

aid of a hand lens. By spring these objects will have matured into the fruit-bodies of a fungus that has been identified as *Aulographum quercinum* Ell. & Mart. This organism has been classified as one of the Hysteriales, but it appears rather to be among the Microthyriaceae in the genus Morenoella, as employed by Theissen and Sydow (1917). The fruiting bodies are external and they open with an irregular, longitudinal fissure. The life history of this fungus, its developmental morphology, pathogenesis, and the taxonomic questions that such studies would elicit should be investigated.

POWDERY MILDEW.—In late summer three different mildews may attack the leaves of our species of oaks. All cause powdery white patches to form; and near the end of summer black fruiting bodies, the perithecia, may be seen scattered over the affected areas. The three species that have been found are *Phyllactinia corylea* (Pers.) Karst., *Microsphaera alni* (DC) Wint., and *M. alni* var. *extensa* C. & P. None induce material damage here, but the last-named species is known to be destructive to oak coppice and to nursery stock in Europe. Whether oak mildews survive the winter here in the perithecial stage or as hibernating mycelium in the buds is unknown.

RUSTS.—Various oaks, including black oak, southern red oak, blackjack oak, swamp chestnut oak, and water oak, are alternate hosts for a common rust, *Cronartium quercuum* (Berk.) Miyabe. On oaks the uredinial and telial stages are formed during May and June. The uredinial stage appears first as small yellowish blisters on the lower leaf surface. This stage is followed by the production of brownish, columnar telial horns, 2 to 3 mm. long. This rust causes no appreciable damage to large oaks, but it appears to be serious on natural reproduction of seedlings or young coppice growth. The aecial stage on yellow pines seriously dwarfs young trees. It can be recognized by headlike or elongated enlargements of the trunk or limbs of pines. The surface of these enlargements becomes covered in spring with yellowish blisters that liberate a profuse mass of yellow powder, the aeciospores. This rust is perennial on pines. Apparently little is known regarding host specialization and infection phenomena on oaks or on pines.

DECAYS.—Oak wood is subject to decay by a large number of species of Basidiomycetes. The following list includes those species found to be associated with decays within the Duke Forest.

Aleurodiscus candidus (Schw.) Burt
Hymenochaete corrugata (Fr.) Lev.
Hymenochaete curtisii (Berk.) Morg.
Hymenochaete sallei B. & C.

Fig. 38. The fruiting body, viewed from the lower surface, of *Daedalea quercina* (L.) Fr. Common on oak logs and stumps. Fruiting bodies are 2-4 x 3-6 inches, grayish, corky, and the pores are arranged like a maze.

Stereum fasciatum (Schw.) Fr.
Stereum frustulosum (Pers.) Fr.
Stereum lobatum Kze.
Stereum ramale Schw.
Stereum sericeum (Schw.) Sacc.
Stereum subpileatum B. & C.
Irpex pachyodon (Pers.) Quel.
Manina cordiformis Scop.
Manina flagellum Scop.
Daedalea confragosa (Bolt.) Fr.
Daedalea quercina (L.) Fr.
Fomes applanatus (Pers.) Gill.
Fomes everhartii (Ell. & Gall.) v. Schr.
Fomes igniarius (L.) Gill.
Ganoderma curtisii (Berk.) Murr.
Ganoderma lucidum (Leys.) Karst.
Lenzites betulina (L.) Fr.
Merulius incarnatus Schw.
Merulius tremellosus Schrad.
Polyporus arcularius (Batsch.) Fr.
Polyporus cinnabarinus Fr.
Polyporus cinnamomeus (Jacq.) Fr.
Polyporus frondosus (Dicks.) Fr.
Polyporus gilvus (Schw.) Fr.
Polyporus graveolens (Schw.) Fr.
Polyporus hirsutus (Wulf.) Fr.
Polyporus hispidus (Bull.) Fr.
Polyporus obtusus Berk.
Polyporus pargamenus Fr.
Polyporus sanguineus (L.) Fr.
Polyporus sulphureus (Bull.) Fr.
Polyporus tulipiferus (Schw.) Overh.
Polyporus versicolor (L.) Fr.
Poria versiporia Pers.
Armillaria mellea (Vahl) Fr.
Claudopus nidulans (Pers.) Pk.
Crepidopus minutus (Pk.) Murr.
Panus rudis Fr.
Pleurotus ostreatus Quel.
Pleurotus petalloides Bull.
Pleurotus spathulatus (Fr.) Pk.
Pleurotus ulmarius Fr.
Pleuteolus reticulatus Fr.
Pluteus cervinus Schaeff.
Schizophyllum alneum (L.) Schroet.

Most of these fungi occur on logs and stumps but they may, in addition, be found on living trees or on dead branches of living trees.

Those species found to be most common and destructive as causes of decay of trunks of standing timber include: *Armillaria mellea* (Vahl) Fr., *Fomes everhartii* (Ell. & Gall.) v. Schr., *Fomes igniarius* (L.) Gill., *Manina cordiformis* Scop., *Polyporus obtusus* Berk., *P. sulphureus* (Bull.) Fr., and *Polyporus graveolens* (Schw.) Fr. These species have been quite extensively studied.

Armillaria mellea can be distinguished by the presence of clusters of 12 to 20 mushrooms that arise from the bases of diseased trees or from the roots. The mushrooms are honey-colored, and their upper surface is viscid or sticky. Their stems or stipes are partly fused. These clusters of fruiting bodies develop from strands that traverse the cambial region. The strands are popularly called "shoe strings" and technically called rhizomorphs. They are hard, black, much interlaced and branched, and extend in all directions throughout the bark. They also extend through the soil around affected trees, and spread by this means to near-by trees. After an affected tree has been killed the honey mushroom fungus continues for several years to grow throughout its trunk and roots.

Fomes igniarius causes a white heart rot of oaks and of other species of trees. It can be recognized by the hoof-shaped brackets

Fig. 39. Clusters of *Armillaria mellea*, the honey mushroom, near base of oak tree.

or punks that form at the sites of branch scars or in holes left where the bases of the branches decayed. These brackets are woody, and vary in width from 2 to 10 inches. They have a charred appearance above and are black, furrowed, rough, and cracked. The lower surface, consisting of the pore layer, is rusty brown, a new layer being formed each year. This fungus seems to be a wound parasite, and once it has become established within the heartwood it may also involve the sapwood. After a time it may penetrate to the newest sapwood, and, as a consequence, kill the tree or the invaded portion.

Fomes everhartii causes a disease that is very similar to that caused by *F. igniarius*. Its brackets are woody and develop in wounds and branch scars. Their upper surface is dark rusty brown, and is deeply cracked and fissured. The pore surface is reddish brown and the pores are exceedingly small.

Manina cordiformis, commonly called the hedgehog fungus, possesses fruiting bodies that range from 5 to 10 inches in diameter and are nearly globular in outline. They are snowy white, fleshy, and consist mainly of a large number of long spines upon whose surface the spores are borne. This fungus has been noted on oaks and various other species of hardwoods. It apparently gains entrance through branch stubs, causing a wet, soggy type of decay. Eventu-

Fig. 40. *Fomes everhartii* (Ell. & Gall.) v. Schr., the cause of heartwood rot of oak. The sporophores are large, blackish and much fissured.

ally the wood becomes spongy, or is wholly decayed and cavities appear, or the heartwood may all be destroyed leaving a shell of sapwood. The fruiting bodies may not develop until many years after the tree was first infected.

Black oak, post oak, and blackjack oak in this region are subject to a heart rot caused by *Polyporus obtusus*. It appears to be especially destructive to trees grown on very infertile sites. The fruiting bodies, appearing in late fall and winter, constitute the most trustworthy means of identifying this disease. They are thick, hoof-shaped, and large. The upper surface is grayish and hairy, and extends over the thick rounded edge for about one-eighth inch. The pore surface is yellowish and consists of very large, irregular, jagged-edged tubes.

A report of a preliminary study of this heart rot disease was made by Spaulding (1905). Evidently the fungus enters through tunnels made by borers, and spreads upward and downward from these points. The trunks become weakened as the heartwood is decayed, and within a few years affected trees may be broken during storms. Attention should be given in this area especially to whether the death of blackjack oaks at an early age is caused by this fungus.

The sulphur polypore, *Polyporus sulphureus,* is widely distributed, and, besides oaks, it can attack many species of deciduous trees and conifers. Both the fruiting bodies and the type of decay are distinctive. The fruiting bodies form a series of a few to a dozen or more overlapping shelves producing a mass 6 to 12 or more inches across. They are orange red to sulphur yellow in color, soft and fleshy when young, but at maturity become quite hard and firm.

Fig. 41. The cause of one of the heart rots of oaks, *Polyporus graveolens* (Schw.) Fr. The fruiting body is composed of many overlapping grayish-brown pilei.

The decayed wood contains radial, tangential and transverse cracks with sheets of white mycelium occupying the cracks, thus isolating cubes of decomposing wood. Eventually these cubes are reduced to a red-brown mass that can be crumbled into powder when rubbed between the fingers. Mature trees appear to be most subject to attack.

Polyporus graveolens is another of the heart-rotting species. Its fruiting bodies are distinctive, consisting of a globose mass of numerous, overlapping shelves that are graying brown to cinnamon brown in color.

The most common causes of sapwood rots are *Polyporus versicolor*, *P. pargamenus*, *P. sangineus*, *P. gilvus*, *P. cinnabarinus*, *Daedalea confragosa*, *Lenzites betulina*, and *Hymenochaete curtisii*. Detailed studies of most of these forms remain yet to be accomplished.

SMOOTH PATCH.—A disease called "smooth patch," "smooth bark," or "white patch" commonly occurs on white oak, *Quercus alba* L., and post oak, *Quercus stellata* Wang. It may be recognized by light gray, irregular areas from a few inches to more than a foot across. The outer bark of diseased areas sloughs off, leaving them smoother than surrounding tissue. Invaded tissues are very friable and can be crumbled if pressed between the thumb and fingers. In winter shallow, irregular, gray disks about one thirty-second to one sixteenth inch in diameter may appear scattered over the lesions. These are the fruiting bodies of *Aleurodiscus oakesii* (B. & C.) Cke. Our observations indicate that fruiting bodies rarely occur in this area and that a study should be made of the primary cause of smooth patch.

Tehon and Jacks (1933) reported that *A. oakesii* is responsible for smooth patch and that the organism does not possess the ability to attack living phloem but only disintegrates the suberized tissues. The ability to digest suberin rapidly does not appear to be a property possessed by many fungi, although species that occur on the bark of living trees may be expected to utilize suberin.

PINES

NEEDLE CAST.—Needle cast, so-called because the needles are shed prematurely, is among the most common diseases of pines in this region. It attacks not only the pines found occurring naturally within the Duke Forest as loblolly pine, *Pinus taeda* L., shortleaf pine, *P. echinata* Mill., and Virginia pine, *P. virginiana* Mill., but also those in plantations of white pine, *P. strobus* L., slash pine. *P.*

Fig. 42. *Polyporus sanguineus* (L.) Fr., a cinnabar-red, leathery polypore very commonly present especially on oak wood.

caribaea Morelet, red pine, *P. resinosa* Ait., and longleaf pine, *P. palustris* Mill. It is widely prevalent throughout this country and Europe. Its most conspicuous symptom is the reddish to brownish discoloration of the older foliage. A large proportion of the needles on seedlings and young trees may become brown and necrotic. This condition is most noticeable on the lower branches, especially if the stands are crowded. The most reliable means of identifying this disease are the small, black, fruiting bodies, elliptical in outline, that occur on the oldest diseased leaves. These structures form within

the leaf tissues and may not be evident until after the needles are dead or have remained for a time on the ground.

Needle cast is caused by *Lophodermium pinastri* (Schrad.) Chev., which belongs in a group of organisms treated in a recent taxonomic monograph by Darker (1932). Tehon (1935) states that *Lophodermium pinastri* occurs on Picea and Abies, and that the fungus on pines should be designated *Lophodermium pinicolum* Tehon.

Infection experiments with *L. pinastri,* involving cross-inoculations, should yield information of value. A study of infection phenomena and of pathogenesis should be made in this region where several crops of new needles are formed during the 12-month period. Periods of infection do not appear to correspond with those reported in Europe. Needle cast has not been studied in the United States, although it has been extensively studied in Europe (Jones, 1935).

NEEDLE RUSTS.—The needle rusts, caused by the Peridermium stages of several species of Coleosporium, are abundant on seedlings and small trees. The needle rusts cause leaf cast with consequent stunting. The rusts of pines possess a complicated cycle of development and usually require two separate host species. The aecial stage occurs on pine needles, and the uredinal and telial stages on various species of herbaceous plants. Identification of species of Coleosporium is difficult, and is most satisfactorily known after inoculations have been made, under controlled conditions, from the aecial to the telial host and reciprocally from the telial to the aecial host.

The rusts are characterized by tubular or tongue-shaped structures, pinkish to pale orange in color, that project prominently from the surface of the needles. These are the Peridermium or aecial stage, and from them may be dusted oblong spores, the aeciospores. Aecia appear in spring on needles one or more years old.

Recent students of these rusts have combined into a single species several that were formerly considered distinct. Those of our collections still regarded as distinct species include: *C. carneum* Jackson, *C. elephantopodis* (Schum.) Thüm., *C. ipomoeae* (Schum.) Burr., *C. solidaginis* (Schw.) Thüm., *C. terebinthinaceae* (Schw.) Arth., *C. vernoniae* B. & C., and *C. viguierae* D. & A. Apparently *C. solidaginis* is the most abundant. A comprehensive comparative study of these species should be made the better to enable identification in their Peridermium stages. Definite information on extent and amount of damage which they occasion is wholly lacking. Con-

Fig. 43. Needles of longleaf pine. At left, normal needles; in middle, stunted needles on which occur numerous brown lesions caused by *Septoria acicola* (Thüm.) Sacc.; at right, needles with necrotic tips caused by the brown spot fungus.

ceivably, they may thin stands of natural reproduction and thereby be beneficial by increasing the profitableness of the remaining stand.

STEM RUST.—One of the most conspicuous rusts of pines is *Peridermium cerebrum* Pk. that produces globoid to fusiform galls on the branches and main stem of loblolly pine and shortleaf pine. This constitutes the aecial stage, and the uredinal and telial stages appear on the leaves of oaks. The rust is perennial in pine, and its aeciospores cause infection on black oak, blackjack oak, swamp red oak, and scarlet oak in this area.

Some appreciation of the taxonomic difficulties that intrigue the student of pine rusts, of the problems involved in their life histories, and of the need for detailed knowledge regarding dissemination and infection, can be gained from studies by Rhoads and his colleagues (1918).

BROWN SPOT.—The brown spot disease, reported to be caused by *Septoria acicola* (Thüm.) Sacc., is among the most destructive maladies on longleaf pine seedlings, on which it causes defoliation and stunting. In this country it was first reported in 1923 in Louisiana on longleaf pine and is now known to occur in eleven states of the southeastern United States. It is known to occur also on *Pinus taeda* L., *P. caribaea* Morelot, *P. echinata* Mill., *P. virginiana* Mill., *P. rigida* Mill., *P. ponderosa* Laws., *P. glabra* Walt., and *P. nigra austriaca* Schmid. (Hedgecock, 1929). The disease is characterized by the presence of gray-green, later brown, irregularly circular spots that girdle the needles and kill the portions beyond the point of attack. Its control in nurseries has been satisfactorily accomplished by means of sprays, either Bordeaux mixture or lime-sulphur. After the seedlings become 4 to 5 feet tall the damage from this disease is not material (Siggers, 1932).

Mycologists have applied several names to the brown-spot organism and related species, and its nomenclature remains confused. It is very apparent that it is not a species of Septoria, that it possesses a perfect stage, and that a study should be made of its morphology, life history, suscept range, hibernation, and of the pathological anatomy of its suscepts.

RED RING-ROT.—To foresters, red ring-rot of coniferous trees is no doubt the best-known tree disease. It is perhaps the most destructive coniferous heartwood rot, and involves practically all cone-bearing species except junipers. It was first studied by Hartig in 1874. Numerous studies, made subsequently, have added to our knowledge

Fig. 44. Brown spot lesions on needles of longleaf pine.

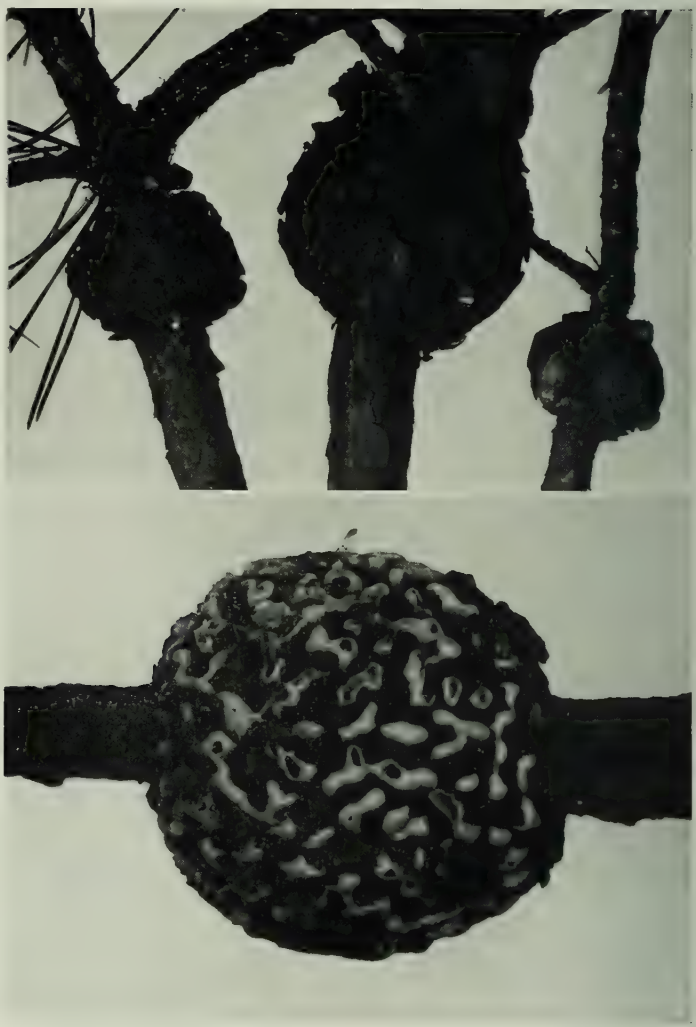

Fig. 45. Galls on *Pinus echinata* Mill. caused by the Peridermium stage of the rust, *Cronartium quercuum* (Berk.) Miyabe. The three galls above are in dormant condition, the one below shedding spores. The other stages of this rust occur in various species of oaks.

of the disease. These results and those of his own work are summarized in a report by Percival (1933).

Red ring-rot is caused by *Fomes pini* (Thore) Lloyd, and may

be detected by the presence of the characteristic fruiting bodies or conks. They are large, bracket-shaped to hoof-shaped, the upper surface is grayish to brownish black with concentric ridges, and the under side is brownish with irregular pores.

Weir and Hubert (1919) studied the age of western white pine as related to the incidence of infection by *F. pini*, and found that earliest infections occur when trees are approximately fifty years old. Hadden (1934) noted that infection in white pine may occur much earlier. There is a direct correlation between age and incidence of disease, the older the trees the greater the percentage of infected

Fig. 46. Brown telial horns of rust, *Cronartium quercuum* (Berk.) Miyabe, on lower surface of black oak leaf.

Fig. 47. Pine branches attacked by the sapwood destroying fungus, *Polyporus abietinus* (Dicks.) Fr. The effused to resupinate, leathery pilei are hairy and grayish above, and white, brown, or violaceous below.

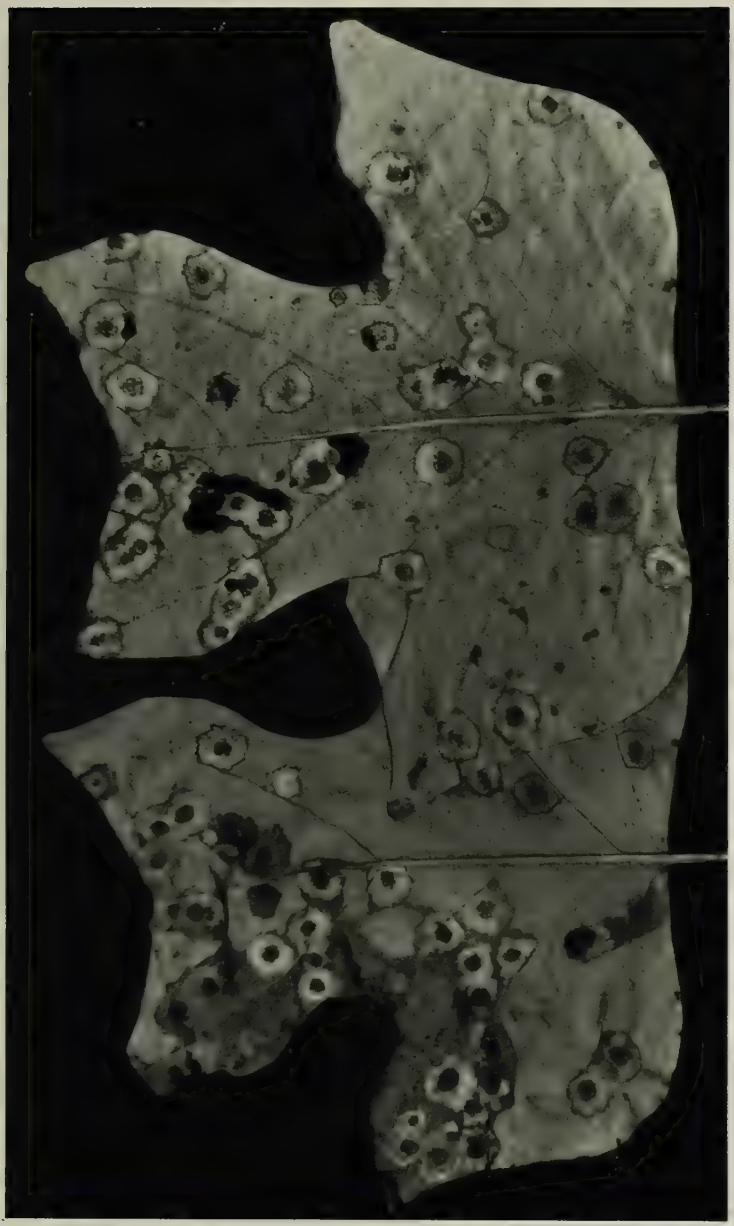

Fig. 48. Gray spot of tulip poplar. The whitish weft that covers the lower surface of the lesions consists of the fruiting parts of *Toruloidea tulipifera* (Ell. & Mart.) Sumstine.

trees. While only 6 to 7 percent of western white pines were found to be infected in the 61 to 80-year age class, 97 percent were infected in trees 200 or more years old. Furthermore, trees in the 121 to 160-year age class bore the largest number of conks per tree. Ring-rot involves loblolly pine, shortleaf pine, and Virginia pine, in the Duke Forest, and the recording of data on incidence of this disease as related to age class should be instituted in connection with the felling of our species of pines.

YELLOW OR TULIP POPLAR

GRAY LEAF SPOT.—No diseases involving the foliage of yellow poplar, *Liriodendron tulipifera* L., except those of minor importance, have been observed. Of these, a gray leaf spot disease is most noticeable. Lesions on the lower shaded leaves were found to be invaded by *Toruloidea tulipifera* (Ell. & Mart.) Sumstine. Nothing is known about its pathogenesis, distribution, and prevalence. In fact, little is known about the organism except that several collectors have found it on foliage of yellow poplar. It may develop that *Toruloidea tulipifera* merely invades tissues previously killed by *Phyllosticta liriodendrica* Sacc.

POWDERY MILDEW.—The foliage of seedlings, grown under crowded conditions, or in shade, may become covered over with one of the powdery mildews, *Erysiphe polygoni* DC. Apparently large trees escape infection.

TWIG DECAY.—The lower limbs of yellow poplar and of certain other trees including oak, maple, and apple may be decayed by *Polyporus tulipiferus* (Schw.) Overh. It forms effuse, white fructifications, shelving along the margins, on the lower side of the limbs. The lower surface is toothed and, in consequence, has been regarded as a species of Irpex. The organism is very common and very abundant in this area, and it causes the wood rapidly to become very light and friable. A thoroughgoing biological study should be made of this organism.

SLIME FLUX.—An exudation or flux from yellow poplar is a common condition and appears to constitute the most serious disease of this species in this region. Little knowledge is available on slime flux of any species beyond the fact that various microorganisms occur within the fermenting, decaying exudate. This problem and the similar condition of oaks and elms, as previously indicated, should be studied. An appreciation of the status of our knowledge of

Fig. 49. An effuse or resupinate polypore, *Polyporus tulipiferus* (Schw.) Overh., that is very prevalent on limbs of tulip poplar. The pilei are whitish and villous above and the pore surface is toothed or Irpex-like.

slime flux diseases can be gained by consulting a publication by Stautz (1931).

RED BUD

LEAF SPOT.—This beautiful ornamental tree is remarkably free from serious diseases. Only one disorder has been noted which appears worthy of study. This disease is manifest by the presence of indefinite-margined, brown, leaf lesions. Associated with these lesions is an imperfect fungus, *Cercospora cercidicola* Ell. Essentially all that is known about this organism is its gross morphological fea-

Fig. 50. *Daedalea confragosa* (Bolt.) Fr. on trunks of willow.

tures together with something of its distribution as indicated by records of collections.

DWARF SUMAC

Dwarf sumac is of no commercial importance aside from its value as an ornamental plant. Two of its diseases appear to have some interest for the mycologist. One of these is the leaf curl or leaf blister disease caused by *Taphrina purpurascens* (E. & E.) Robinson which should be studied, as previously pointed out, in comparison with related species occurring on oak, cherry, and plum. The other

is a very common and abundant leaf spot disease caused by *Cercospora rhoina* Cke. & Ell. This disease appears in late summer and fall and is manifest by the formation of angular, dark brown to black lesions. The life history and developmental morphology of the pathogen should be given consideration.

SYCAMORE

Anthracnose.—Sycamore is subject, in this area, to two serious blight diseases. One is best known as anthracnose and has been extensively investigated, the other is little known and appropriately might be designated sooty leaf blight.

Anthracnose is also commonly called leaf and twig blight, and is generally prevalent throughout the eastern United States. It is first evident in spring when the developing twigs and leaves may turn brown and die. Later mature leaves, especially the tissues along the veins and the immediately adjoining laminar tissues, become necrotic. As a result, the leaves may fall in such profusion that the trees are bare by late summer when a new crop of foliage may develop. Sunken cankers may appear on the twigs, girdling and eventually killing them.

Anthracnose is caused by *Gnomonia veneta* (Sacc. & Speg.) Kleb. The conidial stage of this organism, *Gloeosporium nervisequum* (Fckl.) Sacc., is present throughout spring and summer. The perithecial stage develops on twig cankers and decaying leaves, and is mature in spring. Most of our knowledge regarding this pathogen comes from the studies of Klebahn (1905) and Edgerton (1908).

Sooty Leaf Blight.—This leaf blight is much more commonly present in this region than anthracnose. It has been confused with anthracnose because the latter is generally well known to foresters as a leaf blight disease. It also is manifest by a blighting and premature defoliation but can be differentiated by the effuse dark coating on the lower leaf surface. The presence of this coating, the conidial stage, *Stigmina platani* (Fckl.) Sacc., constitutes a certain means of identifying sooty leaf blight. The coating may be confined to spots or may occupy the greater part of the leaf surface. It is present for a considerable period before the leaves become necrotic and is intimately associated with another pathogenic conidial species, *Cercospora platanicola* E. & E.

This disease complex has been studied for several years, and a recent report (1938) shows that the organisms hibernate on decay-

Fig. 51. At top, *Daedalea confragosa* (Bolt.) Fr. The brackets are light brown and zonate, and the pore surface is lamellate. They range from 1-4 x 1-6 inches.
In the center, *Lenzites saepiaria* (Wulf.) Fr. the cause of brown sapwood rot both of conifers and hardwoods. The sporophores are reddish brown, with lamellate or daedaleoid pores.
At the botton, *Polyporus gilvus* (Schw.) Fr., a yellowish brown polypore, common on hardwoods.

ing leaves. Both *Stigmina platani* and *Cercospora platanicola* possess a perithecial stage, that of the former being *Mycosphaerella stigmina-platani* Wolf, and of the latter, *M. platanifolia* Cke.

BLACK WILLOW

RUST.—In summer, if willow leaves that become yellowish are examined closely, they will be found to be affected with rust. Orange yellow powdery pustules may densely occupy the lower leaf surfaces. This constitutes the uredinal stage of the rust. Toward the end of summer small, dark brown, raised spots are interspersed among the

Fig. 52. *Ganoderma lucidum* (Leys.) Karst. from base of living oak. The stem and upper surface of the pileus are bright red and of a lacquered appearance.

yellow pustules, and are the telial stage of the rust. Severely infected leaves are shed prematurely.

Apparently two species of willow rusts occur in this area, *Melampsora abieti-caprearum* Tubeuf and *M. bigelowii* Thüm. The former is the more common. They are difficult to distinguish in their uredinal stages. Both are heteroecious, however, the former bearing

Fig. 53. Above and at the left, two sporophores of *Fomes pini* (Thore) Lloyd; at right two sporophores of *Polyporus obtusus* Berk.; below, *F. pini*, showing a pileus 18 inches across. *F. pini* causes red ring rot of conifers, *P. obtusus*, a heartwood rot of black oaks.

its pycnial and aecial stages on fir, and the latter on larch. Neither of these alternate hosts occur within the Duke Forest. The rust is therefore compelled to survive by means of its uredinal stage. A study should be made of the mode of hibernation of these rusts, and of the initiation of infection each year on new foliage.

FIR-FERN RUST

Among the fir-fern rusts, *Uredinopsis macrosperma* (Cooke) Magn. is the only species that has been observed within the Duke Forest. Its telial and uredial stages occur on *Pteridium latiusculum* (Desv.) Hieron. Since the alternate hosts, species of fir, do not occur in this region, the rust is forced to maintain itself autoeciously. Its biology, under this condition, is worthy of study. Recent studies by Kamei (1930) show that aeciospores develop on *Abies mariana* Mill. on leaves of the current season if teliospores from fern are sown upon them.

The monographic studies by Faull (1932, 1934) on the closely related genus Milesia, could be utilized as a stimulating guide to a study of *Uredinopsis macrosperma.*

REFERENCES

Boyd, E. Sophia. 1934. A developmental study of a new species of Ophiodothella. *Mycol.* **26**: 456-468.

Crowell, I. H. 1934. The hosts, life history and control of the cedar-apple rust fungus *Gymnosporangium juniperi-virginianae* Schw. *Jour. Arnold Arboretum* **15**: 164-232.

Darker, G. D. 1932. The Hypodermataceae of conifers. *Contrib. Arnold Arboretum* **1**: 1-131.

Ellis, J. B. and B. M. Everhart. 1887. Additions to Cercospora, Gloeosporium and Cylindrosporium. *Jour. Mycol.* **3**: 13-22.

Edgerton, C. W. 1908. The physiology and development of some anthracnoses. *Bot. Gaz.* **45**: 367-408.

Faull, J. H. 1932. Taxonomy and geographical distribution of the genus Milesia. *Contrib. Arnold Arboretum* **2**: 1-138.

———. 1934. Biology of Milesian rusts. *Jour. Arnold Arboretum* **15**: 50-85.

Fitzpatrick, R. E. 1934. The life history and parasitism of *Taphrina deformans. Sci. Agr.* **14**: 305-326.

Hadden, W. B. 1934. An instance of early infection of white pine by *Fomes pini. Forestry* **8**: 155-157.

Hedgecock, G. G. 1929. *Septoria acicola* and the brown spot disease of pine needles. *Phytopath.* **19**: 993-999.

Jones, S. G. 1925. Life history and cytology of *Rhytisma acerinum* (Pers.) Fr. *Ann. Bot.* **39**: 41-75.

———. 1935. The structure of *Lophodermium pinastri* (Schrad) Chev. *Ann. Bot.* **49**: 699-728.

Kamei, S. 1930. On the life history of *Uredinopsis pteridis*, with a special bearing on its peridermial stage. *Ann. Phytopath. Soc.* (Japan) **2**: 207-228.

Kern, F. D. 1911. A biologic and taxonomic study of the genus Gymnosporangium. *N. Y. Bot. Garden Bul.* **7**: 391-494.

Klebahn, H. 1905. Untersuchungen über einige Fungi Imperfecti und die zugehörigen Ascomycetenformen. *Jahr. Wiss. Bot.* **41**: 485-515.

Koch, L. W. 1933. Investigations on the black knot of plums and cherries. I. *Sci. Agr.* **13**: 576-590.

———. 1935. *Ibid.* II-IV. *Idem.* **15**: 80-95, 411-423, 729-744.

MacLachlan, J. D. 1935. The hosts of *Gymnosporangium globosum* Farl. and their relative susceptibility. *Jour. Arnold Arboretum* **16**: 98-142.

———. 1936. Studies on the biology of *Gymnosporangium globosum* Farl. *Jour. Arnold Arboretum* **17**: 1-25.

Martin, Ella M. 1924. Cytological studies of *Taphrina coryli* Nishida. *Trans. Wis. Acad. Sci.* **21**: 345-356.

———. 1925. Cultural and morphological studies of some species of Taphrina. *Phytopath.* **15**: 67-76.

———. 1936. Morphological and cultural studies of *Taphrina potentillae*. *Bot. Gaz.* **98**: 339-347.

Miles, L. E. 1921. Leaf spots of the elm. *Bot. Gaz.* **71**: 161-196.

Miller, J. H. and F. A. Wolf. 1936. A leaf spot disease of honey locust caused by a new species of Linospora. *Mycol.* **28**: 171-180.

Miller, J. K. 1935. A new species of Keithia on red cedar. *Jour. Elisha Mitchell Sci. Soc.* **51**: 167-171.

Mix, A. J. 1935. The life history of *Taphrina deformans*. *Phytopath.* **25**: 41-66.

Nannfeldt, J. A. 1932. Studien über die Morphologie und Systematik der nichtlichenisierten inoperculaten Discomyceten. *Nov. Acta Reg. Soc. Sci. Upsalensis Ser.* **4**. 368 pp.

Pady, S. M. 1934. The role of intracellular mycelium in systemic infections of Rubus with the orange-rust. *Mycol.* **27**: 618-637.

Percival, W. C. 1933. A contribution to the biology of *Fomes pini* (Thore) Lloyd (*Trametes pini* (Thore) Fries). *N. Y. State Col. Forestry Tech. Pub.* **40**. 72 pp.

Pires, Vivian A. 1927. Concerning the morphology of Microstroma and the taxonomic position of the genus. *Amer. Jour. Bot.* **15**: 132-140.

Rhoads, A. S., G. G. Hedgecock, E. Bethel, and C. Hartley. 1918. Host relationships of the North American rusts, other than Gymnosporanguim, which attack conifers. *Phytopath.* **8**: 309-351.

Siggers, P. V. 1932. The brown-spot needle blight of longleaf pine seedlings. *Jour. Forestry* **30**: 579-593.

———. 1934. Observations on the influence of fire on the brown spot needle blight of longleaf pine seedlings. *Jour. Forestry* **32**: 556-562.

Spaulding, P. 1905. A disease of black oaks caused by *Polyporus obtusus* Berk. *Ann. Rept. Mo. Bot. Garden* **16**: 109-116.

Stautz, W. 1931. Beiträge zur Schleimflussfrage. *Phytopath. Zeitschr.* **3**: 163-229.

Stewart, V. B. 1916. The leaf blotch disease of horse chestnut. *Phytopath.* **6**: 5-19.

Tehon, L. R. 1935. A monographic rearrangement of Lophodermium. *Ill. Biol. Monog.* **13**. 151 pp. illus.

Tehon, L. R. and W. R. Jacks. 1933. Smooth patch, a bark lesion of white oak. *Jour. For.* **31**: 430-433.

Theissen, F. and H. Sydow. 1917. Synoptische Tafeln. *Ann. Mycol.* **15**: 389-491.

Verrall, A. F. 1934. The dissemination of *Septoria acicola* and the effect of grass fires on it in pine needles. *Phytopath.* **26**: 1021-1024.

Weir, J. R. and E. E. Hubert. 1919. A study of the rots of western white pine. *U. S. Dept. Agr. Bul.* **799.** 24 pp.

Wolf, F. A. 1929. The relationship of *Microstroma juglandis* (Bereng.) Sacc. *Jour. Elisha Mitchell Sci. Soc.* **25**: 130-136.

———. 1935. The perfect stage of a leaf spot fungus on red mulberry. *Jour. Elisha Mitchell Sci. Soc.* **51**: 163-166.

———. 1936. False mildew of red mulberry. *Mycol.* **28**: 268-277.

———. 1938. Life histories of two leaf inhabiting fungi on sycamore. *Mycol.* **29**: 54-63.

LIST OF FUNGI

The following list includes 570 species of fungi collected in the Duke Forest. Of these 44 are Myxomycetes, 17 are Phycomycetes, 146 are Ascomycetes, 257 are Basidiomycetes, and 106 are Fungi Imperfecti.

As to the number of species within some of the larger subdivisions of these Classes there are 13 Peronosporales, 15 Erysiphaceae, 14 Hypocreales, 42 Sphaeriales, 11 Phacidiales, 22 Pezizales, 75 Uredinales, 25 Thelephoraceae, 50 Polypores, 26 Gasteromycetes, 26 Sphaeropsidales, 15 Melanconiales and 63 Moniliales. Among the largest genera Puccinia includes 35 species, Uromyces 11 species, Stereum 8 species, Fomes 7 species, Polyporus 26 species, Lycoperdon 9 species, Phyllosticta 9 species, and Cercospora 31 species.

CLASS MYXOMYCETES

Subclass Exosporeae

Ceratiomyxa fruticulosa (Muell.) Macbr.
On decaying logs. Common throughout spring and summer.

Subclass Myxogastres

Order Physarales

Family Physaraceae

Badhamia capsulifera (Bull.) Berk.
On decaying wood. January.

Craterium leucocephalum (Pers.) Ditm.
On pine needles. August.

Fuligo septica (L.) Weber
On badly decayed wood. July-October.

Leocarpus fragilis (Dickson) Rost.
On base of cedar and oak trees. July-November.

Physarum citrinum Schum.
On decaying pine log. August.

Physarum globuliferum (Bull.) Pers.
On decaying hardwood log. July.

Physarum oblatum Macbr.
On decaying hardwood log. July.

Physarum pulcherrimum Berk. & Rav.
On decaying hardwood stump. July.

Physarum pulcherripes Peck.
On rotten pine log. August.

Physarum viride (Bull.) Pers.
On rotten wood. July.

Family Didymiaceae

Didymium crustaceum Fr.
On lawns, in gardens, on decaying wood. Common throughout summer.

Didymium nigripes (Link) Fr.
On wood. August.

Order Stemonitales

Family Stemonitaceae

Comatrichia nigra (Pers.) Schroet.
On decaying oak log. July.

Comatrichia typhoides (Bull.) Rost.
On rotting maple wood. June.

Diachea leucopodia (Bull.) Fr.
On dead Smilax sp. August.

Stemonitis axifera (Bull.) Macbr.
On rotten wood. October.

Stemonitis fenestrata Macbr.
On decaying pine log. August.

Stemonitis fusca Roth.
On oak log. July.

Stemonitis pallida Wing.
On badly decayed wood. June.

Stemonitis smithii Macbr.
On decaying hardwood log. June.

Stemonitis splendens Rost.
On decaying wood. August.

Order Liceales

Family Cribariaceae

Cribaria intricata Schrad.
On decaying wood. August.

Cribaria microcarpa (Schrad.) Pers.
On decaying wood. August.

Dictydium cancellatum (Batsch.) Macbr.
On pine wood. July. Parasitized by Oospora sp.

Dictydium cancellatum var. **anomalum** Jahn.
On pine log. August.

Dictydium cancellatum var. **purpureum** Jahn.
On pine log. August.

Family Reticulariaceae

Dictydiaethalium plumbeum (Schum.) Rost.
On rotting log. July-October.

Enteridium rozeanum Wing.
On rotting log. October.

Family Lycogolaceae

Lycogola epidendrum (L.) Fr.
Common on logs throughout entire year.

Order Trichiales

Family Arcyriaceae

Arcyria denudata (L.) Wettstein.
On oak log. July.

Arcyria digitata (Schw.) Rost.
On rotten wood. July.

Arcyria incarnata Pers.
On wood. Summer.

Arcyria magna Rex.
On rotten wood. August.

Arcyria nutans (Bull.) Grev.
On pine log. August.

Arcyria pomiformis (Leers.) Rost.
On wood. Summer.

Lachnobolus occidentalis Macbr.
On pine wood. March-June.

Family Trichiaceae

Hemitrichia clavata (Pers.) Rost.
On oak log. July.

Hemitrichia serpula (Scop.) Rost.
On oak wood. Common throughout the year.

Hemitrichia vesparium (Batsch.) Macbr.
On oak wood. Common throughout the year.

Trichia botrytis (Gmel.) Pers.
On rotten wood. October.

Trichia decipiens (Pers.) Macbr.
On decaying wood. Summer.

Trichia favoginea (Batsch.) Pers.
On bark of *Quercus prinus* L. Spring.

Trichia persimilis Karst.
On wood. Summer.

CLASS PHYCOMYCETES

Subclass Archimycetes

Order Myxochytridiales

Family Synchytriaceae

Rhodochytrium spilanthidis Lagerh.
On *Ambrosia artemisiifolia* L. Common on leaves and stems from June to September.

Synchytrium fulgens Schroet.
On *Oenothera laciniata* Hill. Common on leaves during late autumn, winter and spring.

Synchytrium stellariae Fckl.
On *Stellaria media* L. Abundant throughout spring on leaves and stems.

Subclass Oomycetes

Order Peronosporales

Family Albuginaceae

Albugo bliti (Biv.) O. Kze.
On *Amaranthus spinosus* L. Abundant in summer on leaves.

Albugo candida (Pers. ex Lév.) Kze.
On *Brassica alba* (L.) Boiss. In spring on leaves.
On *Capsella bursa-pastoris* (L.) Medic. In spring on leaves, stems and flowers.
On *Cardamine pennsylvanica* Muhl. In spring on leaves.

On *Sisymbrium thalianum* (L.) J. Gay. In spring on leaves.

Albugo ipomoeae-panduranae (Farl.) Sw.
On *Ipomoea pandurata* (L.) G. F. W. Meyer. Common on leaves and stems.
On *Ipomoea purpurea* (L.) Roth. Common on leaves and stems.

Family Peronosporaceae

Basidiophora entospora Roze & Cornu.
On leaves of *Leptilon canadense* (L.) Britton. April-May.

Bremia lactucae Regel.
On *Lactuca canadensis* L. On leaves.
On *Lactuca scariola* L. On leaves.

Peronospora alsinearum Casp.
On *Cerastium viscosum* L. Common April and May on leaves and stems.
On *Stellaria media* (L.) Cyrill. January. On leaves and stems.

Peronospora geranii Pk.
On leaves of *Geranium carolinianum* L. Abundant during winter and spring.

Peronospora halstedii Farl.
On leaves of *Ambrosia artemisiifolia* L. Rare, in May.

Peronospora parasitica (Pers.) Fr.
On *Brassica rapa* L. On leaves.
On *Sisymbrium thalianum* (L.) J. Gay. February and March. On leaves.

Peronospora plantaginis Underw.
On leaves and inflorescenses of *Plantago aristata Michx.* Common during May.

Peronospora sp.
On *Diodia virginiana* L. Rare. This species appears not to have been described.

Peronospora viciae var. **americanum** Davis.
On leaves of *Vicia angustifolia* Reichard.

Plasmopara viticola (B. & C.) de Toni.
On leaves of *Vitis vinifera* L.

ORDER MUCORALES

Family Mucoraceae

Sporodinia grandis Link.
On Lactarius, Russula, Boletus.

CLASS ASCOMYCETES

Subclass Hemiascomycetes

ORDER TAPHRINALES

Family Taphrinaceae

Taphrina caerulescens (Mont. & Desm.) Tul.
On oak leaves. Very abundant.

Taphrina deformans (Beck.) Tul.
On leaves of *Prunus persica* (L.) Stokes.

Taphrina mirabilis (Atk.) Giesenh.
On twigs, involving buds of *Prunus americana* Marsh and *P. angustifolia* Marsh. Abundant.

Taphrina polystichi Mix.
On *Polystichum acrostichoides* (Michx.) Schott.

Taphrina potentillae (Farl.) Johans.
On leaves of *Potentilla pumila* Poir.

Taphrina purpurascens (E. & E.) Robinson.
Involving foliage of *Rhus copallina* L.

Taphrina varius Atk.
On leaves of *Prunus virginiana* L. and *Prunus serotina* Ehrh.

Subclass Euascomycetales

ORDER EUROTIALES

Family Elaphomycetaceae

Elaphomyces cervinus (Pers.) Schroet.
In soil under short-leaf pine.

ORDER MYRIANGIALES

Family Myriangiaceae

Myriangium curtisii B. & Mont.
On back of limbs of *Nyssa sylvatica* Marsh.

Myriangium duriaei Mont. & Berk.
On limbs of *Nyssa sylvatica* Marsh, *Acer rubrum* L., and of oaks.

Order Dothidiales

Family Dothidiaceae

Acrospermum compressum Tode.
On decaying leaves of *Morus rubra* L. and *Ulmus alata* Michx. In spring.

Acrospermum compressum var. **foliicolum** Berk.
On decaying leaves of *Broussonetia papyrifera* (L.) Vent.

Cymadothea trifolii (Pers.) Wolf.
On leaves of *Trifolium repens* L. *Polythrincium trifolii* Schm. & Kze. is the conidial stage.

Family Phyllachoraceae

Dothidea potentillae Fr.
On leaves of *Potentilla pumila* Poir. Spring.

Phyllachora graminis (Pers.) Fkl.
On leaves of *Digitaria sanguinalis* (L.) Scop.

Phyllachora Pteridis (Reb.) Fkl.
On leaves of *Pteridium latiusculum* (Desv.) Hieron.

Phyllachora solidaginum Sacc.
On leaf lesions on *Solidago* spp. Summer and fall.

Plowrightia morbosa (Schw.) Sacc.
On twigs of *Prunus avium* L. Very abundant.

Rosenscheldia heliopsidis (Schw.) Th. & Syd.
On leaves and stems of *Helianthus divaricatus* L. Summer.

Order Erysiphales

Family Erysiphaceae

Erysiphe cichoracearum (DC) Schroet.
On foliage of *Erigeron ramosus* (Walt.) BSP
On foliage of *Lactuca scariola* L. Common.
On foliage of *Lactuca spicata* (Lam.) Hitch.
On foliage of *Plantago lanceolata* L.
On foliage of *Plantago rugelii* Decaisne.
On foliage of *Plantago major* L. Common.
On foliage of *Xanthium* spp. Common.
On foliage of *Ambrosia artemisiifolia* L. Common.
On foliage of *Ambrosia trifida* L. Very abundant.
On foliage of *Prenanthes* sp.

Erysiphe euphorbiae C. & P.
On foliage of *Euphorbia corollata* L. Summer.

Erysiphe polygoni DC.
On foliage of *Trifolium pratense* L. Very abundant.
On foliage of *Trifolium procumbens* L. Very abundant.
On foliage of *Oenothera biennis* L.
On foliage of *Oenothera laciniata* Hill.
On *Liriodendron tulipifera* L. On seedlings.

Microsphaera alni (DC.) Wint.
On *Viburnum affine* Bush. On foliage.
On *Viburnum pubescens* (Ait.) Pursh. Common both on leaves and fruit.
On *Castanea pumila* (L.) Mill.
On *Quercus rubra* L. Autumn.
On *Quercus phellos* L. Autumn.

Microsphaera alni var. **extensa** C. & P.
On *Quercus borealis maxima* (Marsh) Ashe. On leaves.
On *Quercus alba* L. Autumn.
On *Platanus occidentalis* L.

Microsphaera alni var. **vaccinii** (Schw.) Salmon.
On *Vaccinium tenellum* Ait. On leaves.

Microsphaera diffusa C. & P.
On *Desmodium* spp. On leaves.

Phyllactinia corylea (Pers.) Karst.
On *Quercus alba* L.
On *Ulmus alata* Michx. Very abundant on foliage in September and October.

Sphaerotheca humuli (DC.) Burr.
On *Taraxacum officinale* Weber.

Sphaerotheca pannosa (Wallr.) Lév.
On leaves and buds of *Rosa virginiana* Mill.

Uncinula circinata C. & P.
On leaves of *Acer rubrum* L.

Uncinula flexuosa Pk.
On leaves of *Aesculus neglecta georgiana* Sarg.
On leaves of *Aesculus neglecta pubescens* Sarg.

Uncinula intermedia B. & C.
On *Ulmus alata* Michx. Common on leaves in autumn.

Uncinula macrospora Pk.
On *Ulmus alata* Michx. On leaves.

Uncinula salicis (DC) Wint.
On *Salix nigra* Marsh. On leaves.

Family Capnodiaceae

Parodiella perisporioides (B. & C.) Speg.
On foliage of *Rhynchosia erecta* (Walt.) DC. Summer.
On foliage of *Rhynchosia tomentosa* (L.) H. & A. Summer.

Parodiella paraguayensis Speg.
On foliage of *Convolvulus arvensis* L. Summer.

Scorias spongiosa (Schw.) Fr.
On *Fagus grandifolia* Ehrh.
On *Alnus rugosa* (DuRoi) Spreng.

Stigmatea potentillae Fr.
On leaves of *Potentilla pumila* Poir.

Stigmatea seminata (B. & Rav.) Sacc.
On leaves of *Desmodium canadense* (L.) DC. Summer.

ORDER HYPOCREALES

Family Nectriaceae

Scoleconectria scolecospora (Bref.) Seav.
On fallen pine cones.

Family Hypocreaceae

Claviceps paspali Stev. & Hall.
Destroys ovaries. Sphacelial stage prevalent in summer and fall. Perithecial stage has been developed in spring from hibernated sclerotia.
On *Paspalum laeve* Michx.
On *Paspalum floridanum* Michx.
On *Paspalum dilatatum* Poir. Very abundant.

Chromocrea ceramica (E. & E.) Seav.
On bark of *Juniperus virginiana* L.

Claviceps tripsaci Stev. & Hall.
On spikelets of *Tripsacum dactyloides* L. Only sphacelial stage seen.

Dothichloe limitata Diehl. in edit.
On leaves of *Gymnopogon ambiguus* (Michx.) BSP. Abundant during summer.

Epichloe typhina (P. ex. Fr.) Tul.
On leaf sheathes of *Sphenopholis obtusata* (Michx.) Scribn. Rare in spring.

Hypocrea lenta (Tode) B. & Br.
On decorticated pine logs.

Hypocrea citrina (Pers.) E. & E.
On decaying wood of red maple.

Hypomyces lactifluorum (Schw.) Tul.
On *Lactarius* spp. Very abundant, in summer and autumn.

Cordyceps agariciformia (Bolt.) Seav.
On *Elaphomyces cervinus* (Pers.) Schroet. In sandy soil in short-leaf pine stand.

Cordyceps clavulata (Schw.) E. & E.
On *Lecanium* sp.

Cordyceps sphingum (Tul.) B. & C.
On *Sphingidae*.

ORDER SPHAERIALES

Herpotrichia pezizula (B. & C.) E. & E.
On red maple bark.

Tympanopsis euomphala (B. & C.) Starb.
On decorticated ash.

ORDER SPHAERIALES

Family Amphisphaeriaceae

Caryospora putaminum (Schw.) de Not.
On pits of plums and peaches. Common.

Chaetosphaeria pannicola (B. & C.) Sacc.
On decaying wood.

Lasiophaeria strigosa (A. & S.) Sacc.
On decaying wood.

Rosellinia subiculata (Schw.) Sacc.
On decaying oak wood.

Rosellinia aquila (Fr.) de Not.
On decorticated wood and maple wood. Common.

Family Mycosphaerellaceae

Guignardia aesculi Stewart
Involves foliage of *Aesculus neglecta pubescens* Sarg. Very common and abundant in summer and autumn.

Guignardia bidwellii (Ell.) Viala and Ravaz.
On leaf lesions on *Vitis rotundifolia* Michx.
On *Psedera quinquefolia* (L.) Greene.

Mycosphaerella arachnoidea Wolf.
On leaves of *Morus rubra* L. *Cercosporella arachnoidea* Wolf is the conidial stage.

Mycosphaerella caroliniana Wolf.
On decaying leaves of *Oxydendrum arboreum* (L.) DC. Fall.

Mycosphaerella confusa Wolf.
On decaying leaves.
On *Rubus* spp. *Cercospora rubi* Sacc. is conidial stage.
Both stages collected.

Mycosphaerella mori (Fkl.) Wolf.
On foliage of *Morus rubra* L. *Phleospora mori* (Lev.) Sacc. is conidial stage. Both stages collected.

Mycosphaerella persica Hig. & Wolf.
On foliage.
On decaying leaves of *Prunus persica* (L.) Stokes. *Cercosporella persica* Sacc. is conidial stage. Both stages collected.

Mycosphaerella platanifolia Cke.
On decaying leaves of *Platanus occidentalis* L. *Cercospora platanifolia* E. & E. is conidial stage. Both stages collected.

Mycosphaerella rubi Roark.
On leaves of *Rubus* spp. *Septoria rubi* Westd. is conidial stage.

Mycosphaerella stigmina-platani Wolf.
On decaying leaves of *Platanus occidentalis* L. *Stigmina platani* (Fckl.) Sacc. is conidial stage. Both stages collected.

Mycosphaerella ulmi Kleb.
On decaying leaves of *Ulmus alata* Michx., *U. americana* L., and *U. fulva* Michx. *Phleospora ulmi* (Fr.) Wallr. is the conidial stage.

Sphaerella brunnea (B. & C.) Cke.
On foliage of *Acer rubrum* L.

Family Pleosporaceae

Didymellina iridis (Desm.) Höhn
On *Iris cristata* Ait.

Leptosphaeria dryophila (Cke. & Höhn.) Sacc.
On leaves of *Quercus velutina* Lam.

Family Gnomoniaceae

Gnomonia ulmea (Schw.) Thüm.
On leaves.
On *Ulmus americana* L. *Gloeosporium ulmeum* (Schw.) Miles is conidial stage. Both stages collected.

Gnomonia veneta (Sacc.) Kleb.
On leaves and twigs.
On *Platanus occidentalis* L. *Gloeosporium nervisequum* (Fckl.) Sacc. is conidial stage. Perithecia not seen.

Family Clypeosphaeriaceae

Linospora gleditsiae Miller & Wolf.
Involves leaves.
On *Gleditsia triacanthos* L. Common.
Melasmia hypophylla (B. & Rav.) Sacc. is the conidial stage. Both stages collected.

Family Melogrammataceae

Endothia gyrosa Fr.
On roots of oak and *Liquidambar styraciflua* L.
On branches of *Fagus grandifolia* Ehrh.

Family Diatrypaceae

Diatrype albopruinosa (Schw.) Cke.
On decaying oak wood.

Diatrype discoidea var. **alni** Cke.
On dead branches of *Alnus rugosa* (DuRoi) Spreng.

Diatrype infuscans E. & E.
On *Smilax* sp. stems.

Diatrype megalostoma E. & E.
On branches of *Alnus rugosa* (DuRoi) Spreng.

Diatrype stigma (Hoff.) De Not.
On decaying oak and maple wood.

Diatrype virescens (Schw.) E. & E.
On decaying beech wood. Throughout winter.

Diatrypella prominens (Howe) E. & E.
On decaying sycamore wood.

Eutypella stellulata (Fr.) Sacc.
On alder limbs.

Family Xylariaceae

Daldinia concentrica Bolt.
On decaying oak log.

Daldinia vernicosa Schw.
On wounds on living oak.

Hypoxylon atropunctatum (Schw.) Cke.
On decaying oak wood.

Hypoxylon fuscum (Pers.) Fr.
On dead alder branches. Common and abundant.

Hypoxylon punctulatum (B. & Rav.) Cke.
On oak wood.

Hypoxylon rubiginosum (Pers.) Fr.
On decaying alder, oak, and maple wood. Very abundant.

Hypoxylon truncatum (Schw.) Mill.
On decaying oak wood.

Nummularia discreta (Schw.) Tul.
On *Pyrus malus* L.

Penzigia frustulosa (B. & C.) Mill.
On oak wood.

Ustulina vulgaris Tul.
On badly decayed wood.

Xylaria hypoxylon (L.) Grev.
On decaying oak wood.

Xylaria polymorpha (Pers.) Grev.
On decaying wood.

ORDER HYSTERIALES

Family Hypodermataceae

Glonium stellatum Muhl.
On decaying oak log.

Lophodermium pinastri (Schrad.) Chev.
On needles of *Pinus taeda* L. and *P. echinata* Mill.

Family Hysteriaceae

Aulographum quercinum Ell. & Mart.
On leaves of *Quercus velutina* Lam. and *Q. borealis maxima* (Marsh) Ashe.

Hysterium pulicare Pers.
On bark of *Betula nigra* Marsh.

Hysterium smilacis Schw.
On stems of *Smilax glauca* Walt.

Hysterographium viticola (C. & P.) Rehm.
On canes of *Vitis rotundifolia* Michx.

Hysterographium vulvatum Schw.
On dead oak twigs.

ORDER PHACIDIALES

Family Stictidaecae

Stictis radiata (L.) Pers.
On pine cones.

Family Phacidiaceae

Clithris juniperi (Karst.) Rehm.
On recently killed branches and needles of red cedar.

Clithris quercina Pers.
On oak wood.

Keithia juniperi Miller
On scale leaves of *Juniperus virginiana* L.

Macroderma curtisii (B. & Rav.) Höhn
On foliage of *Ilex opaca* Ait.

Phacidium elegantissimum B. & C.
On foliage of *Ilex opaca* Ait. Spring

Rhytisma acerinum (Pers.) Fr.
On leaves of *Acer rubrum* L.

Rhytisma curtisii B. & Rav.
On leaves of *Ilex opaca* Ait. Spring

Rhytisma decolorans Fr.
On foliage of *Lyonia ligustrina* (L.) DC.

Rhytisma ilicinicola (Schw.) Fr.
On leaves of *Ilex decidua* Walt.

Rhytisma vaccinii (Schw.) Fr.
On leaves of *Polycodium neglecta* (L.) Small.
On leaves of *Vaccinium* spp.

ORDER HELOTIALES

Family Helotiaceae

Arachnopeziza aurelia Fckl.
On acorn cups.

Chlorocyphe cedrina (Cke.) Seav.
On dead branches of *Juniperus virginiana* L. The type collection of this species constitutes the only one of this species in the New York Botanical Gardens.

Orbilia chrysocoma (Bull.) Sacc.
On decaying wood.

Sclerotinia fructicola (Wint.) Rehm.
On *Prunus americana* Marsh. and *P. angustifolia* Marsh. On fruits, twigs, and on galls formed by *Taphrina mirabilis* (Atk.) Giesenh.
On *Prunus persica* (L.) Stokes.

Family Mollisiaceae

Tapesia fusca (Pers.) Fkl.
On decaying wood.

Family Geoglossaceae

Geoglossum glabrum Pers.
On badly decayed wood. Summer.

Leotia stipitata (Bosc.) Schroet.
On leaf mold. Summer.

Microglossum olivaceum (Pers.) Gill.
On badly decayed stump. Summer.

Microglossum rufum (Schw.) Underw.
On badly decayed stumps. Summer.

Trichoglossum hirsutum (Pers.) Boud.
On badly decayed stumps. Summer.

Family Pezizaceae

Bulgaria melastoma (Schw.) Seav.
Base of *Juniperus virginiana* L. March.

Bulgaria rufa Schw.
On decaying twigs.

Calycina macrosporum (Fkl.) Seav.

Coryne sarcoides (Jacq.) Tul.
On decaying oak logs. Fall.

Dasyscypha ellisiana (Rehm.) Sacc.
Common on bark of pines throughout the year.

Discina apiculata (Cke.) Seav.
On damp soil.

Helvella crispa (Scop.) Fr.
On humus. Spring.

Helvella elastica Bull.
On humus. Spring.

Lamprospora wrightii (B. & C.) Seav.
Among moss on bark of cedars, not hitherto reported north of Alabama.

Morchella conica Pers.
On humus. Spring.

Patella albida (Schaeff.) Seav.
On rotten oak log.

Patella melaloma (Alb. & Schw.) Seav.
On burned soil.

Patella setosa (Nees.) Seav.
On decaying deciduous wood. Very common and abundant. Fall.

Patella scutellata (L.) Morg.
On decaying oak wood.

Paxina nigrella Seav.
On cedar wood.

Peziza reganda Pers.
On ground. Spring.

Pezicula carpinea (Pers.) Tul.
On decaying Carpinus wood.

Pitya cupressi (Batsch.) Rehm.
On cedar leaves. August.

Plectania occidentalis (Schw.) Seav.
On buried wood.

Pseudoplectania nigrella (Pers.) Fkl.
On humus. April.

Urnula craterium (Schw.) Fr.
On decaying oak logs. Common in spring.

Wolfina aurantiopsis (Ell.) Seav.
On soil, leaf mold, and badly decomposed wood.

CLASS BASIDIOMYCETES

Subclass Heterobasidiomycetes

ORDER TREMELLALES

Family Dacryomycetaceae

Arrhytidia involutus (Schw.) Coker
On pine wood. Winter.

Dacryopsis ceracea Coker
On maple wood.

Ditiola radicata (Alb. & Schw.) Fr.
On decaying pine wood.

Exida recisa (Dittm.) Fr.
On oak and maple logs. Abundant in winter and spring.

Exidia glandulosa (Bull.) Fr.
Very abundant on coniferous wood throughout the year.

Guepinia elegans B. & C.
On decaying wood. Summer.

Guepinia spathularia (Schw.) Fr.
On decaying pine and hardwood. Fall and winter.

Family Tremellaceae

Tremella fuciformis Berk.
Collected once at base of oak stump.

Tremella lutescens Pers.
On decaying *Liquidambar styraciflua* L. Winter.

Tremella pinicola Britz.
Abundant on pine wood, following rains. Spring.

Tremellodendron candidum (Schw.) Atk.
On soil. Summer.

Tremellodendron merismatoides (Schw.) Burt.
On soil. Summer.

Tremellodon gelatinosum(Scop.) Pers.
On decaying pine wood.

Family Aurichlariaceae

Auricularia auricula-judae (L.) Berk.
Common on decaying deciduous wood in all stages of decay.

Platygloea caroliniana Coker.
On decaying hardwood.

Septobasidium apiculatum Couch
On branches of *Hamamelis virginiana* L. This constitutes a new host species.

Septobasidium castaneum Burt.
On limbs of *Quercus phellos* L.

Septobasidium curtisii (B. & D.) Boed. & Steinm.
On branches of *Fagus grandifolia* Ehrh., *Cornus florida* L., *Fraxinus americana* L., and *Nyssa sylvatica* Marsh.

Septobasidium pseudopedicellatum Burt.
On branches of *Ulmus americana* L., *U. alata* Michx., *Fraxinus americana* L., *Cornus florida* L., and *Carpinus caroliniana* Walt.

ORDER UREDINALES

Family Melampsoraceae

Coleosporium carneum Jackson
On leaves of *Vernonia altissima* Nutt.

Coleosporium elephantopodis (Schw.) Thüm.
On stems and foliage of *Elephantopus tomentosus* L.

Coleosporium inconspicuum (Long) Hedgc. & Long.
On leaves of *Coreopsis grandiflora* Hogg.

Coleosporium ipomoeae (Schw.) Burr.
On leaves.
On *Ipomoea hederacea* Jacq., *I. purpurea* (L.) Roth; *I. pandurata* (L.) G. F. W. Meyer; *I. quamoclit* L.; and *Convolvulus arvensis* L.

Coleosporium solidaginis (Schw.) Thüm.
On *Solidago canadensis* L. On leaves.
On *Pinus taeda* L. On leaves.

Coleosporium terebinthinaceae (Schw.) Arth.
On foliage.
On *Silphium integrifolium* L.
On *Silphium asteristicus* L.

Coleosporium vernoniae B. & C.
On *Vernonia altissima* Nutt.
On *Pinus taeda* L.
On *Pinus echinata* Mill.

Coleosporium viguierae D. & H.
On leaves of *Verbesina virginica* L.

Cronartium quercuum (Berk.) Miyabe
On *Quercus* spp. On leaves.
On *Pinus* spp. On trunk and branches.

Melampsora abieti-capraerum Tubeuf.
On leaves of *Salix nigra* Marsh.

Melampsora bigelowii Thüm.
On leaves of *Salix nigra* Marsh.

Uredinopsis macrosperma (Cooke) Magn.
On leaves of *Pteridium latiusculum* (Desv.) Hieron.

Family Pucciniaceae

Aecidium apocyni Schw.
On leaves, *Apocynum cannabinum* L.

Gymnoconia interstitialis (Schlecht.) Lagerh.
On leaves of *Rubus* spp.

Gymnoconia peckiana (Howe) Trotter.
On foliage of *Rubus trivialis* Michx.

Gymnosporangium clavipes Cke. & Pk.
On *Juniperus virginiana* L. On trunks and branches.
On *Amelanchier canadensis* (L.) Medic. On leaves.

Gymnosporangium externum Arth. & Kern.
On Gillenia stipulata (Muhl.) Trel.
On leaves.

Gymnosporangium globosum Farl.
On *Juniperus virginiana* L. Galls on leaves.
On *Crataegus* spp. On leaves and fruits.

Gymnosporangium juniperi-virginianae Schw.
On *Juniperus virginiana* L. Forming galls on leaves.
On *Pyrus coronaria* L. On leaves.

Gymnosporangium nidus-avis Thax.
Forming witches brooms on *Juniperus virginiana* L.

Kuehneola uredinis (Pk.) Arth.
On foliage of *Rubus argutus* Link.

Kunkelia nitens (Schw.) Arth.
On leaves and young canes of *Rubus* spp.

Phragmidium americanum (Pk.) Diet.
On leaves of *Rosa virginiana* Mill.

Phragmidium potentillae (Pers.) Karst.
On leaves.
On *Potentilla pumila* Poir.
On *Potentilla canadensis* Raf.

Pileolaria toxicodendri (B. & Rav.) Arth.
On leaves of *Rhus toxicodendron* L.

Puccinia acetosae (Schum.) Körn.
On *Rumex acetosella* L.

Puccinia andropogonis gerardiae (Pk.) Arth.
On leaves of *Aureolaria flava* (L.) Farwell.

Puccinia andropogonis penstemonis (Schw.) Arth.
On foliage.
On *Penstemon canescens* Britt.
On *Penstemon laevigatus* Sol.

Puccinia angustata var. **typica** Arth.
On *Scirpus* sp.

Puccinia argentea (Schultz) Wint.
On leaves and stems of *Impatiens biflora* Walt.

Puccinia bolleyana Sacc.
Involves leaves and young stems of *Sambucus canadensis* L.

Puccinia cooperiae Long.
On leaves of *Zephyranthes atamosco* (L.) Herb. Not previously known to occur in North Carolina.

Puccinia cyani (Schleich.) Pass.
On leaves, *Centaurea cyanus* L.

Puccinia cyperi Arth.
On *Cyperus* sp.

Puccinia eatoniae-myosotidis Mains.
On leaves of *Myosotis virginica* (L.) BSP.

Puccinia eleocharidis Arth.
On leaves of *Eupatorium rotundifolium* L.

Puccinia extensicola erigerontis Arth.
On foliage of *Erigeron ramosus* (Walt.) BSP.

Puccinia extensicola oenotherae (Mont.) Arth.
On young leaves of *Oenothera fruticosa* L. and *O. laciniata* Hill.

Puccinia extensicola solidaginis (Schw.) Arth.
On *Solidago canadensis* L. and *S. altissima* L.

Puccinia graminis Pers.
On *Dactylis glomerata* L.

Puccinia graminis var. **Poae** Erikss. & Henn.
On *Poa pratensis* L.

Puccinia helianthi Schw.
On *Helianthus divaricatus* L., *H. angustifolius* L., *H. rigidus* (Cass.) Desf., *H. scaberrimus* Ell. and *H. strumosus* L.

Puccinia hieracii (Schum.) Mart.
On leaves and stems.
On *Pyrrhopappus carolinianus* (Walt.) DC.
On *Hieracium venosum* L.

Puccinia marylandica Lindr.
On *Sanicula canadensis* L.

Puccinia menthae Pers.
On *Cunila origanoides* (L.) Britt.

Puccinia podophylli Schw.
On foliage of *Podophyllum peltatum* L.

Puccinia polygoni-amphibii convolvuli (Alb. & Schw.) Arth.
On *Polygonum* spp.

Puccinia polysora Underw.
On *Tripsacum dactyloides* L.

Puccinia rubigo-vera agropyri (Erikss.) Arth.
On *Holcus lanatus* L.
On *Cimicifuga racemosa* (L.) Nutt.

Puccinia rubigo-vera agropyrina (Erikss.) Arth.
On *Clematis viorna* L.

Puccinia rubigo-vera impatientis (Arth.) Mains.
On leaves and stems.
On *Impatiens biflora* Walt.

Puccinia seymouriana Arth.
On leaves of *Asclepias variegata* L.

Puccinia smilacis Schw.
On foliage of *Smilax hispida* Muhl.

Puccinia spegazzinii de Toni
On *Mikania scandens* (L.) Willd.

Puccinia tripsaci D. & H.
On *Tripsacum dactyloides* L.

Puccinia verbesinae Schw.
On *Actinomeris alternifolia* (L.) DC.
On *Verbesina occidentalis* (L.) Walt.

Puccinia violae (Schum.) DC.
On *Viola* spp. Spreads to pansies from diseased violets.

Puccinia virgata E. & E.
On *Sorghastrum nutans* (L.) Nash.

Puccinia windsoriae Schw.
On *Triodia flava* (L.) Smyth.

Puccinia xanthii Schw.
On *Xanthium* spp. Very common.

Pucciniastrum pyrolae (Pers.) Schroet.
On *Chimaphila maculata* (L.) Pursh.

Ravenelia epiphylla (Schw.) Diet.
On *Tephrosia virginiana* (L.) P.

Transchelia pruni-spinosae (Pers.) Diet.
On *Prunus persica* (L.) Stokes, *P. cerasus* L., and *P. serotina* Ehrh. On foliage.

Uromyces caladii (Schw.) Farl.
On leaves.
On *Arisaema dracontium* (L.) Schott.

Uromyces fabae (Pers.) de By.
On foliage of *Lathyrus venosus* Muhl.

Uromyces hedysari-paniculati (Schw.) Farl.
On leaves.
On *Desmodium laevigatum* (Nutt.) DC., *D. marylandicum* F. Bott., *D. paniculatum* (L.) DC.

Uromyces houstoniatus (Schw.) Sheldon.
On *Houstonia patens* Ell.

Uromyces junci (Desm.) Tul.
On *Juncus* sp.

Uromyces lespedezae-procumbentis (Schw.) Michx.
On *Lespedeza capitata* Michx., and *L. repens* (L.) Bart.

Uromyces phaseoli var. **strophostylis** Arth.
On *Strophostyles umbellata* (Muhl.) Britt.

Uromyces plumbarius Pk.
On *Oenothera laciniata* Hill.

Uromyces spermacoces (Schw.) C.
On *Diodia virginiana* L.

Uromyces trifolii-hybridi (Davis) Arth.
On *Trifolium hybridum* L. Common.

Uromyces trifolii hybridi var. **trifolii-repentis** (Liro) Arth.
On *Trifolium repens* L. Common.

ORDER USTILAGINALES

Family Ustilaginaceae

Sorosporium ellisii Wint.
On spikelets of *Andropogon virginicus* L.

Sorosporium everhartii Ell. & Gall.
Ovaries of *Andropogon scoparius* Michx.

Ustilago bromivora (Tul.) Fisch. Wald.
On spikelets of *Bromus* sp.

Ustilago perennans Rostr.
On spikelets of *Arrhenatherum elatius* (L.) Beauv.

Ustilago rabenhorstiana Kühn.
On spikelets of *Digitaria sanguinalis* (L.) Scop.

Family Tilletiaceae

Doassansia martianoffiana (Thüm.) Schroet.
On leaves of *Potamogeton natans* L.

Subclass Homobasidiomycetes

ORDER AGARICALES

Family Exobasidiaceae

Exobasidium vaccinii (Fkl.) Wor.
On leaves.
On *Rhododendron catawbiense* Michx.
On *Azalea nudiflora* L.
On *Vaccinium tenellum* Ait.

Family Thelephoraceae

Aleurodiscus candidus (Schw.) Burt.
Common on bark of living *Quercus alba* L. and *Q. stellata* Wang., throughout the year, rarely on hickory.

Aleurodiscus nivosus (B. & C.) H. & Litsch.
On cedar branches.

Aleurodiscus oakesii (B. & C.) Cke.
On *Quercus alba* L.
On *Quercus stellata* Wang.

Coniophora olivascens (B. & C.) Massee.
On pine bark.

Corticium caeruleum (Schrad.) Fr.
On limbs of maple.

Corticium lilacino-fuscum B. & C.
On oak limbs.
On apple branches.

Hymenochaete corrugata (Fr.) Lév.
Very common on dead limbs of oaks.

Hymenochaete curtisii (Berk.) Morg.
Abundant throughout the year on dead limbs of oaks.

Hymenochaete sallei B. & C.
On oak logs. Fall.

Peniophora albomarginata (Schw.) Massee.
On branches of deciduous trees. In winter.

Peniophora aurantiaca Bres.
On branches of *Alnus rugosa* (DuRoi) Spreng.

Peniophora gigantea (Fr.) Massee.
On pine logs and slash. Very common and destructive.

Peniophora mutata (Pk.) Bres.
On oak wood. August.
On sweet gum. February.

Solenia anomala (Pers.) Fkl.
On dead trunks and limbs of *Alnus rugosa* (DuRoi) Spreng. Fall.

Sparassis crispa (Wulf.) Fr.
On pine roots. October.

Stereum fasciatum (Schw.) Fr.
On oak logs. Winter.

Stereum frustulosum (Pers.) Fr.
On sound oak stumps and logs, also on hickory. Very abundant throughout the year.

Stereum fuscum Schrad.
On dead branches of *Liquidambar styraciflua* L.

Stereum gausapatum Fr.
Common on oak logs and stumps.

Stereum lobatum Kze.
On oak logs throughout the year.

Stereum rameale Schw.
On twigs of various deciduous trees as oak, beech, hornbeam, alder, red gum, plum, also on cedar. Throughout the fall and winter.

Stereum sericeum (Schw.) Sacc.
On wood of *Quercus* spp., *Prunus serotina* Ehrh., *Betula nigra* L., and *Liquidambar styraciflua* L. Abundant throughout the year.

Stereum subpileatum B. & C.
On oaks. In summer.

Thelephora albido-brunnea Schw.
At base of young trees of *Juniperus virginiana* L., *Viburnum rufidulum* Raf., *Amelanchier canadensis* (L., Medic., *Fraxinus americana* L., *Acer rubrum* L., *Quercus alba* L., and *Carpinus caroliniana* Walt.

Thelephora caespitulans Schw.
On humus under dense stands of old pines. August.

Thelephora palmata (Scop.) Fr.
On sandy soil, under pines. August.

Thelephora regularis Schw.
On ground, in woods. August.

Thelephora terrestris Ehrh.
On ground in eroded sites. Very common and abundant throughout summer. On seedlings also.

Family Hydnaceae

Hydnella velutinum Fr.
On humus. August.

Hydnum adustum Schw. (**Steccherinum adustum** (Schw.) Banker).
On decaying wood. July.

Hydnum imbricatum L.
On humus. October.

Hydnum underwoodii Banker
On humus. August.

Irpex pachyodon (Pers.) Quel.
On oak logs. March.

Manina cordiformis Scop. (**Hydnum erinaceus** Fr.)
On trunks of living *Quercus alba* L., *Q. velutina* Lam., *Nyssa sylvatica* Marsh, *Platanus occidentalis* L., and *Liriodendron tulipifera* L. Summer and fall.

Manina flagellum Scop. (**Hydnum coralloides** Scop.)
On logs of deciduous woods. Summer.

Family Polyporaceae

Daedalea confragosa (Bolt.) Pers.
On logs and branches. Fall and winter.
On *Liquidambar styraciflua* L., *Acer rubrum* L., *Cornus florida* L., *Pinus* sp., *Carpinus caroliniana* Walt., *Quercus* spp., *Betula nigra* L., *Fagus grandifolia* Ehrh., *Salix nigra* Marsh.

Daedalea quercina (L.) Fr.
On oak stumps and logs. Common and abundant throughout the year.

Daedalea unicolor (Bull.) Fr.
On branches of white oak.

Favolus alveolaris (DC) Quel.
On fallen branches of *Acer rubrum* L. and other deciduous trees. Not common.

Favolus ciliaris Mont.
On dead vines of *Tecoma radicans* (L.) Juss.

Fomes annosus (Fr.) Cke.
At bases of dead *Juniperus virginiana* L. and pines. Throughout fall and winter.

Fomes applanatus (Pers.) Gill.
On dead oak trees. Not common.

Fomes everhartii (Ell. & Gall.) V. Schr.
On oak stumps and on living *Q. velutina* Lam., and *Q. stellata* Wang.

Fomes fomentarius (L.) Gill.
Not common. On deciduous trees.

Fomes igniarius (L.) Gill.
Rather common on living oaks.

Fomes pini (Thore) Lloyd
Causes heart rot in living pines, rather common.

Fomes pomaceus (Pers.) Lloyd
On apple trees in abandoned orchards, on plum trees, not common.

Ganoderma curtisii (Berk.) Murr.
On stumps and at base of living oaks.

Ganoderma lucidum (Leyss.) Karst.
On decaying oak wood, and on living oak and sycamore trees. Spring.

Lenzites betulina (L.) Fr.
On wood of *Cornus florida* L., *Acer* sp., and *Quercus* sp., and *Betula nigra* L. Abundant throughout the winter.

Lenzites saepiaria (Wulf.) Fr.
On pine wood. Not common.

Merulius ambiguus Berk.
On pine logs. Not common.

Merulius incarnatus Schw.
On oak logs. In summer.

Merulius tremellosus Schrad.
On oak logs, spring and summer.

Polyporus abietinus (Dicks.) Fr.
On cedar and pine wood. Very common and abundant throughout the entire year.

Polyporus adustus (Willd.) Fr.
Very common on deciduous wood, as oak, maple, willow and sycamore, also on cedar and pine during spring and summer.

Polyporus arcularius (Batsch.) Fr.
On oak logs. Very abundant, in spring.

Polyporus berkeleyi Fr.
At base of red cedar trees. Summer.

Polyporus caesius (Schrad.) Fr.
On pine wood. Summer.

Polyporus cinnabarinus Fr.
On branches of alder, oaks, black cherry, birch, pine and maple trees. Common throughout the year.

Polyporus cinnamomeus (Jacq.) Fr.
On logs of pines and oaks. In summer and fall.

Polyporus conchifer (Schw.) Fr.
On elm branches. Throughout the year, common and abundant.

Polyporus distortus (Schw.) Fr.
On decaying deciduous logs. Summer.

Polyporus elegans (Bull.) Fr.
On maple wood. Summer.

Polyporus frondosus (Dicks.) Fr.
On oak stumps. Autumn.

Polyporus gilvus (Schw.) Fr.
On decaying wood and on living trees of oaks, hickory, birch, beech, red bud and sycamore. Throughout the year.

Polyporus graveolens (Schw.) Fr.
On trunks of living oaks.

Polyporus hirsutus (Wulf.) Fr.
On wood of *Salix nigra* Marsh, oaks, cedar, *Sassafras variifolium* (Salisb.) Kze., *Gleditsia triacanthos* L.

and *Liriodendron tulipifera* L. Fall and winter.

Polyporus hispidus (Bull.) Fr.
On *Quercus phellos* L. Fall.

Polyporus montagnei Fr.
On decaying wood. Summer. Rare.

Polyporus obtusus Berk.
On living *Quercus velutina* Lam., *Q. marilandica* Muench., and *Q. stellata* Wang. Common in winter.

Polyporus pargamenus Fr.
Very common and very abundant on deciduous wood, rarely on coniferous wood, throughout the year, as beech, birch, red maple, and oaks.

Polyporus picipes Fr.
On oak log.

Polyporus resinosus (Schrad.) Fr.
On base of living cedars. Winter.

Polyporus sanguineus (L.) Fr.
On logs of oak, maple and other deciduous trees. Summer and fall.

Polyporus schweinitzii Fr.
At bases of living pines. Spring and summer.

Polyporus sulphureus (Bull.) Fr.
At bases of living oaks. Rare.

Polyporus tulipiferus (Schw.) Overh.
On branches of apple, yellow poplar, maple and oak. Common and abundant.

Polyporus ursinus Lloyd.
On pines. Fall. Rare.

Polyporus versicolor (L.) Fr.
On oak and many other hardwoods, also on cedar. Common and abundant throughout the year.

Poria cocos (Schw.) Wolf.
On roots of pines, collected in sclerotial or tuckahoe stage.

Poria ferruginosa (Schrad.) Fr.
On pine wood. Spring.

Poria rufa Schrad.
On pine branches. Spring.

Poria subfusco-flavida Fr.
On wood of *Pinus taeda* L. Winter.

Poria versipora Pers.
On oak branches. Fall and winter.

Trametes heteromorpha (Fr.) Lloyd
On cedar. Throughout the year.

Family Boletaceae

Strobilomyces strobilaceus Berk.
On humus. Summer.

Family Agaricaceae

Agaricus campestris Fr.
On ground. Summer.

Agaricus silvicola Vittad.
On ground. Summer.

Amanita caesarea Fr.
On leaf mold. June and July.

Amanita chlorinosma Pk.
On humus. July.

Amanita muscaria Fr.
On leaf mold. Summer.

Amanita phalloides Fr.
On humus. July and August.

Amanita solitaria Fr.
On humus. July-September.

Amanitopsis vaginata Fr.
On leaf mold. Summer and fall.

Armillaria mellea (Vahl.) Fr.
At base of living oaks, also near stumps of sweet gums and maples.

Cantharellus aurantiacus Fr.
On very moist ground in dense shade. Midsummer.

Cantharellus cinnabarinus Schw.
In deep hardwood shade. July and August.

Claudopus nidulans (Pers.) Pk.
On oak and pine stumps and logs. Fall and winter.

Clitocybe pulcherrima Pk.
Very common, during summer, on humus.

Craterellus cornucopioides L.
In deep shade, near streams, among hardwoods. July.

Craterellus ochrosporus Burt.
On soil under hardwoods. August.

Crepidopus herbarum Pk.
On living dogwood and maple. July.

Crepidopus minutus (Pk.) Murr.
On birch, oak, and hickory logs. Fall and winter.

Lactarius piperatus (L.) Pers.
On soil. Common and very abundant throughout summer.

Lactarius subplinthogalus Coker.
On ground. July.

Lentinus umbilicatus Pk.
On decaying pine logs. August.

Marasmius fagineus Morg.
On log of *Quercus alba* L. August.
Marasmius resinosus (Pk.) Sacc.
On oak logs. August.
Marasmius rotula Fr.
On decaying oak log. July.
Marasmius rubophyllus Pennington.
On the ground. June.
Marasmius siccus (Schw.) Fr.
On decaying leaves. Summer.
Mycena alkalina Fr.
On willow logs. July.
Mycena corticola Schum.
On bark of oak trees after rains. July and August.
Omphalia epichysium Pers.
On decaying wood. July.
Panus rudis Fr.
On oak and red gum stumps; very common in spring.
Panus torulosus Fr.
On oak stumps.
Pleurotus applicatus Batsch.
On pine wood. March.
On cedar wood. July.
Pleurotus ostreatus Quel.
On oaks, maples, hornbeams, and yellow poplars. Fall.
Pleurotus petaloides Bull.
On oak wood. April.
Pleurotus spathulatus (Fr.) Pk.
On oak logs. July.
Pleurotus ulmarius Fr.
On oak and tulip poplar logs. February.
On living trees of *Acer rubrum* L. and *Salix nigra* Marsh. August.
Pluteolus reticulatus Fr.
On injured bark of living oaks. January.
Pluteus cervinus Schaeff.
On oak stumps. May.
Psathyrella disseminata Fr.
On bark of living trees, *Cornus florida* L., *Betula nigra* L., *Quercus alba* L. and *Liquidambar styraciflua* L. July and August, during rainy periods.
Russula emetica Fr.
On humus, very common and abundant throughout summer and autumn.
Russula magna Coker.
On leaf mold. July.
Russula variata Bann. & Pk.
On leaf mold. July.
Schizophyllum alneum (L.) Schroet.
On twigs of pine, oak, hickory, willow, dogwood, poison oak, also on wounds of deciduous trees. Common throughout the entire year.
Trogia crispa Fr.
On decaying wood of oak, trumpet creeper, willow, and sycamore. July.

ORDER PHALLALES

Family Phallaceae

Simblum sphaerocephalum Schlecht.
On humus. Summer.

ORDER LYCOPERDALES

Family Lycoperdaceae

Calvatia craniformis (Schw.) Fr.
On ground. Summer and fall.
Calvatia cyathiformis (Bosc.) Morg.
On ground. Summer.
Calvatia rubro-flava (Crag.) Lloyd
On soil. July.
Lycoperdon curtisii Berk.
On leaf mold. Summer and fall.
Lycoperdon gemmatum Batsch.
On decaying logs. Late summer and autumn.
Lycoperdon marginata Vittad.
On soil. Summer.
Lycoperdon mirabilis Mont.
On humus. Summer.
Lycoperdon peckii Morg.
On soil. Summer.
Lycoperdon pulcherrimum B. & C.
On ground. Summer.
Lycoperdon pyriforme Schaeff.
On badly decayed logs. Autumn.
Lycoperdon subincarnatum Pk.
On oak logs. Summer.
Lycoperdon umbrinum Pers.
On soil. Summer.

Family Geasteraceae

Geaster arenarius Lloyd
On ground. Summer.
Geaster coronatus (Schaeff.) Schroet.
On ground. Summer.

Geaster velutinus Morg.
On ground under pines. Summer.

Family Sclerodermataceae

Pisolithus tinctorius Pers.
In compacted soil. Late summer and autumn.

Scleroderma cepa (Vaill.) Pers.
On leaf mold. Summer.

Scleroderma geaster Fr.
In clay soils, in cuts along roads. Summer.

Scleroderma lycoperdoides Schw.
On ground. Summer.

Family Astreaceae

Astraeus hygrometricus (Pers.) Morg.
On humus. Summer.

Family Tulostomataceae

Tylostoma simulans Lloyd
On ground. Summer.

Family Calostomataceae

Calostoma cinnabarina Desv.
On soil near stump. Summer.

Calostoma ravenelii (Berk.) Massee
On leaf litter. Fall.

Order Nidulariales

Family Nidulariaceae

Crucibulum vulgare Tul.
On hardwood twigs, on bark of living cedar, also on burlap sack lying on ground. Summer.

Cyathus striatus Willd.
On decaying oak wood. Summer.

Cyathus vernicosus DC.
On cedar wood. Summer.

CLASS FUNGI IMPERFECTI

Order Phyllosticiales

Family Sphaeriodaceae

Ascochyta viciae Lib.
On *Vicia* sp. and *V. angustifolia* Reichard. Spring and summer.

Cicinnobolus cesatii de By.
Parasitic on powdery mildew, *Erysiphe cichoracearum* (DC.) Schroet., on *Prenanthes* sp. and on *Erigeron ramosus* (Walt.) BSP.

Darluca filum Cast.
On *Phragmidium potentillae* (Pers.) Karst.

Depazea brunnea B. & C.
On *Acer rubrum* L. Summer.

Phleospora mori (Lév.) Sacc.
On *Morus rubra* L. The conidial stage of *Mycosphaerella mori* (Fkl.) Wolf.

Phleospora ulmi (Fr.) Wallr.
On *Ulmus alata* Michx., *U. americana* L. and *U. fulva* Michx. Common in summer.
The conidial stage of *Mycosphaerella ulmi* Klebahn.

Phyllosticta acericola E. & E.
On *Acer rubrum* L.

Phyllosticta atriplicis Desm.
On *Chenopodium album* L.

Phyllosticta convallariae Pers.
On *Smilacina racemosa* (L.) Desf. Late summer and fall.

Phyllosticta decidua Ell. & Kellerm.
On *Agrimonia striata* Michx.

Phyllosticta liriodendrica Sacc.
On leaves of *Liriodendron tulipifera* L.

Phyllosticta negundinis Sacc. & Speg.
On *Acer negundo* L.

Phyllosticta oxydendri E. & E.
On *Oxydendrum arboreum* (L.) DC. Conidial stage of *Mycosphaerella caroliniana* Wolf.

Phyllosticta pallidior Pk.
On *Smilacina racemosa* (L.) Desf.

Phyllosticta viridis Ell. & Kellerm.
On *Fraxinus americana* L.

Phyllostictina minima (B. & C.) Underw. & Earle.
On *Acer saccharinum* L.

Septoria acicola (Thüm.) Sacc.
On leaves of loblolly pine, short-leaf pine and longleaf pine.

Septoria hepaticae Desm.
On *Hepatica americana* (DC.) Ker. Early spring.

Septoria oenotherae Westd.
On leaf lesions on *Oenothera laciniata* Hill, and *O. biennis* L. Very common throughout the year.

Septoria quercicola (Desm.) Sacc.
On leaves of *Quercus borealis maxima* (Marsh.) Ashe.

Septoria rubi Westd.
On leaves of *Rubrus* spp.

Septoria verbascicola B. & C.
On *Verbascum blattaria* L.

Sphaerographium fraxini (Pk.) Sacc.
On dead limbs of *Fraxinus americana* L.

Sphaeropsis gleditschiicola Cke.
On pods of *Gleditsia tricanthos* L.

Sphaeropsis malorum Pk.
On leaves of *Pyrus prunifolia* Willd.

Family Leptostromataceae

Leptothyriella liquidambaris Tehon & Stout
On leaf spots on *Liquidambar styraciflua* L.

ORDER MELANCONIALES

Family Melanconiaceae

Colletotrichum higginsianum Sacc.
On *Brassica nigra* (L.) Koch.

Colletotrichum lineola var. **halepensis** Heald and Wolf.
On *Sorghum halepensis* (L.) Pers.

Cylindrosporium hiemalis Higgins
On *Prunus cerasus* L. The conidial stage of *Coccomyces hiemalis* Higgins.

Cylindrosporium lactucicola E. & E.
On *Lactuca scariola* L.

Cylindrosporium lutescens Higgins
On *Prunus serotina* Ehrh. The conidial stage of *Coccomyces lutescens* Higgins.

Cylindrosporium rubi Ell. & Morg.
On *Rubus* spp.

Discosia artocreas (Tode) Fr.
On *Rubus* spp., and sycamore.

Gloeosporium aridum E. & H.
On *Fraxinus americana* L. Early spring.

Gloeosporium caryae Ell. & Dearn.
On *Hicoria* sp.

Gloesporium nervisequum (Fckl.) Sacc.
On *Platanus occidentalis* L.

Gloeosporium ulmeum (Fckl.) Miles
On *Ulmus americana* L.

Marssonia juglandis (Lib.) Sacc.
On *Juglans cinerea* L.

Melasmia hypophylla (B. & Rav.) Sacc.
On foliage of *Gleditsia triacanthos* L. The conidial stage of *Linospora gleditsiae* Miller and Wolf.

Microstroma juglandis (Bereng.) Sacc.
On *Hicoria* spp.

Protocoronospora nigricans Atk. & Edg.
On *Vicia* spp.

ORDER MONILIALES

Family Moniliaceae

Cephaliophora tropica Thax.
On soil. Previously known only from the tropics.

Monilia cinerea Bon.
On fruits of *Prunus serotina* Ehrh.

Ovularia isarioides (E. & E.) Sacc.
On *Staphylea trifolia* L.

Ovularia obliqua (Cke.) Oud.
On *Rumex crispus* L.

Piricularia euphorbiae Atk.
On *Euphorbia presslii* Guss.

Piricularia grisea (Cke.) Sacc.
On *Digitaria sanguinalis* (L.) Scop.

Ramularia celastri Ell. & Mart.
On *Celastrus scandens* L.

Ramularia lineola Pk.
On *Taraxacum officinale* Weber.

Ramularia lysimachiae Thüm.
On *Steironema ciliatum* (L.) Raf.

Ramularia macrospora Fr.
On *Erigeron annosus* (L.) P.

Ramularia tulasnei Sacc.
On *Fragaria virginiana* Duch.

Toruloidea tulipifera (Ell. & Mart.) Sumstine
On leaf lesions caused by *Phyllosticta liriodendrica* Sacc. on *Liriodendron tulipifera* L.

Family Dematiaceae

Alternaria solani (Ell. & Mart.) Jones & Grout.
On *Datura stramonium* L.

Cercospora acetosellae Ell.
On *Rumex acetosella* L.

Cercospora anthelmintica Atk.
On *Chenopodium ambrosioides* var. *anthelminticum* Gray.

Cercospora boehmeriae Pk.
On *Boehmeria cylindrica* (L.) Sw.

Cercospora brunnea Pk.
On *Prenanthes altissimus* L.

Cercospora catenospora Atk.
On *Sambucus canadensis* L.

Cercospora cerasella Sacc.
On *Prunus cerasus* L. The conidial stage of *Mycosphaerella cerasella* Aderh.

Cercospora cercidicola Ell.
On *Cercis canadensis* L.

Cercospora chenopodii Fr.
On *Chenopodium album* L.

Cercospora chionanthi E. & E.
On *Chionanthus virginica* L.

Cercospora cornicola Tracy & Earle
On Cornus florida L.

Cercospora diodiae-virginianae Atk.
On *Diodia teres* Walt.

Cercospora flagellaris Ell. & Mart.
On *Phytolacca decandra* L.

Cercospora fuliginosa Ell. & Kellerm.
On *Diospyros virginiana* L.

Cercospora fuscovirens Sacc.
On *Passiflora incarnata* L.

Cercospora gerardiae Ell. & Dearn.
On *Aureolaria flava* (L.) Farwell.

Cercospora hieracii Ell. & Ev.
On *Hieracium venosum* L.

Cercospora hydropiperis (Thüm) Speg.
On *Polygonum pennsylvanicum* L.

Cercospora liquidambaris Cke. & Ell.
On *Liquidambar styraciflua* L.

Cercospora liriodendri Ell. & Hark.
On *Liriodendron tulipifera* L. The perithecial stage is *Mycosphaerella tulipiferae* (Schw.) Higgins.

Cercospora macrospora Osterw.
On *Viola* spp.

Cercospora mississippiensis Tracy & Earle
On *Smilax glauca* Walt.

Cercospora platanifolia E. & E.
On *Platanus occidentalis* L.

Cercospora rhoina Cke. & Ell.
On *Rhus copallina* L.

Cercospora rosicola Pass.
On *Rosa virginiana* L.

Cercospora rubi Sacc.
On *Rubus* spp. The conidial stage of *Mycosphaerella confusa* Wolf.

Cercospora sabbatiae E. & E.
On *Sabbatia angularis* (L.) Pursh.

Cercospora smilacina Sacc.
On *Smilax glauca* Walt.

Cercospora sordida Sacc.
On *Tecoma radicans* (L.) Juss.

Cercospora squalidula Pk.
On *Clematis viorna* L.

Cercospora truncatella Atk.
On *Passiflora incarnata* L.

Cercospora viridula E. & E.
On *Ipomoea purpurea* (L.) Lam.

Cercosporella arachnoidea Wolf.
On *Morus rubra* L. The conidial stage of *Mycosphaerella arachnoidea* Wolf.

Cercosporella cana (Pass.) Sacc.
On leaves.
On *Erigeron ramosus* (Walt.) BSP.
On *Leptilon canadense* (L.) Britton.

Cercosporella persica Sacc.
On *Prunus persica* (L.) Stokes. The conidial stage of *Mycosphaerella persica* Hig. & Wolf.

Cladosporium carpophilum Thüm.
On fruit and twigs of *Prunus persica* (L.) Stokes.

Dactylium dendroides (Bull.) Fr.
On *Lenzites betulina* (L.) Fr.
On *Daedalea confragosa* (Bolt.) Pers.

Helminthosporium giganteum Heald & Wolf.
On leaves of *Cynodon dactylon* (L.) P.

Helminthosporium ravenelii C.
On inflorescence of *Sporobolus poiretii* (Roem. & Schult.) Hitch.

Septonema olivaceum Pk.
On oak twigs.

Sporodesmium concinnum Berk.
On decaying wood.

Sporodesmium moriforme Pk.
On maple wood.

Stigmina platani (Fkl.) Sacc.
On *Platanus occidentalis* L. The conidial stage of *Mycosphaerella stigmina-platani* Wolf.

Streptothrix fusca Corda
On twigs of cedar, beech, oaks, and other wood. Common.

Tetraploa divergens Tracy & Earle
On *Panicum boscii* Poir.

Trichoderma lignorum (Tode) Harz.
On decaying wood.

Xenosporella berkeleyi (Curtis) Linder
On bark of dead *Betula nigra* L., *Fraxinus americana* L., *Platanus occidentalis* L.

Family Tuberculariaceae

Coccospora aurantiaca Wallr.
On decaying wood.

Everhartia lignitalis Thax.
On decaying wood.

Fusarium aleyrodis Petch.
On *Lecanium* sp. on *Quercus nigra* L.

Fusarium rubi (Wint.) Berl. & Vogl.
On *Rubus* sp. (*Cercosporella rubi* (Wint.) Plak.)

Tuberculariа vulgaris Tode
On decaying wood.

HOST INDEX

Acer spp.
Comatrichia typhoides
Corticium caeruleum
Dacryopsis ceracea
Diatrype stigma
Exidia recisa
Hypoxylon rubiginosum
Lenzites betulina
Pleurotus ostreatus
Polyporus adustus
Polyporus tulipiferus
Rosellinia aquila
Sporodesmium moriforme
Phyllosticta negundinis

Acer rubrum L.
Armillaria mellea
Crepidopus herbarum
Daedalea confragosa
Depazea brunnea
Favolus alveolaris
Herpotrichia pezizula
Hypocrea citrina
Myriangium duriaei
Phyllosticta acericola
Pleurotus ulmarius
Polyporus cinnabarinus
Polyporus elegans
Polyporus pargamenus
Polyporus sanguineus
Polyporus versicolor
Rhytisma acerinum
Sphaerella brunnea
Thelephora albido-brunnea
Uncinula circinata

Acer saccharinum L.
Phyllostictina minima

Actinomeris alternifolia (L.) DC.
Puccinia verbesinae

Aesculus neglecta pubescens Sarg.
Guignardia aesculi
Uncinula flexuosa

Aesculus neglecta georgiana Sarg.
Uncinula flexuosa

Agrimonia striata Michx.
Phyllosticta decidua

Alnus rugosa (DuRoi) Spreng.
Diatrype discoidea var. *alni*
Diatrype megalostoma
Eutypella stellulata
Hypoxylon fuscum
Hypoxylon rubiginosum
Periophora aurantiaca
Polyporus cinnabarinus
Scorias spongiosa
Solenia anomala
Stereum ramale

Amaranthus spinosus L.
Albugo bliti

Ambrosia artemisiifolia L.
Erysiphe cichoracearum
Peronospora halstedii
Rhodochytrium spilanthidis

Ambrosia trifida L.
Erysiphe cichoracearum

Amelanchier canadensis (L.) Medic.
Gymnosporangium clavipes
Thelephora albido-brunnea

Andropogon scoparius Michx.
Sorosporium everhartii

Andropogon virginicus L.
Sorosporium ellisii

Apocynum cannabinum L.
Aecidium apocyni

Arisaema triphyllum (L.) Schott.
Uromyces caladii

Arrhenatherum elatius (L.) Beauv.
Ustilago perennans

Asclepias variegata L.
Puccinia seymouriana

Aureolaria flava (L.) Farwell
Cercospora gerardiae
Puccinia andropogonis gerardiae

Azalea nudiflora L.
Exobasidium vaccinii

Betula nigra L.
Crepidopus minutus
Daedalea confragosa
Hysterium pulicare
Lenzites betulina
Polyporus cinnabarinus
Polyporus gilvus
Polyporus pargamenus
Polyporus versicolor
Psathyrella disseminata
Stereum sericeum
Xenosporella berkeleyi

Boehmeria cylindrica (L.) Sw.
Cercospora boehmeriae
Boletus sp.
Sporodinia grandis
Brassica alba (L.) Boiss.
Albugo candida
Brassica nigra (L.) Koch.
Colletotrichum higginsianum
Brassica rapa L.
Peronospora parasitica
Bromus sp.
Ustilago bromivora
Broussonetia papyrifera (L.) Vent.
Acrospermum compressum var. *foliicolum*
Capsella bursa-pastoris (L.) Medic.
Albugo candida
Cardamine pennsylvanica Muhl.
Albugo candida
Carpinus caroliniana Walt.
Daedalea confragosa
Pezicula carpinea
Pleurotus ostreatus
Septobasidium pseudopedicellatum
Stereum ramale
Thelephora albido-brunnea
Castanea pumila (L.) Mill.
Microsphaera alni
Celastrus scandens L.
Ramularia celastri
Centaurea cyanea L.
Puccinia cyani
Cerastium viscosum L.
Peronospora alsinearum
Cercis canadensis L.
Cercospora cercidicola
Polyporus gilvus
Chenopodium album L.
Cercospora chenopodii
Phyllosticta atriplicis
Chenopodium ambrosioides var. **anthelminticum** Gray
Cercospora anthelmintica
Chimaphila maculata (L.) Pursh.
Pucciniastrum pyrolae
Chionanthus virginica L.
Cercospora chionanthi
Cimicifuga racemosa (L.) Nutt.
Puccinia rubigo-vera agropyri
Clematis viorna L.
Cercospora squalidula
Puccinia rubigo-vera agropyrina (Erikss.) Arth.
Convolvulus arvensis L.
Coleosporium ipomoeae
Parodiella paraguayensis
Coreopsis grandiflora Hogg.
Coleosporium inconspicuum
Cornus florida L.
Cercospora cornicola
Crepidopus herbarum
Daedalea confragosa
Lenzites betulina
Psathyrella disseminata
Schizophyllum alneum
Septobasidium curtisii
Septobasidium pseudopedicellatum
Crataegus spp.
Gymnosporangium globosum
Cunila origanoides (L.) Britt.
Puccinia menthae
Cynodon dactylon (L.) P.
Helminthosporium giganteum
Cyperus sp.
Puccinia cyperi
Dactylis glomerata L.
Puccinia graminis
Daedalea confragosa (Bolt.) Pers.
Dactylium dendroides
Datura stramonium L.
Alternaria solani
Desmodium spp.
Microsphaera diffusa
Desmodium canadense (L.) DC.
Stigmatea seminata
Desmodium laevigatum (Nutt.) DC.
Uromyces hedysari-paniculati
Desmodium marylandicum F. Bott.
Uromyces heydsari-paniculati
Desmodium paniculatum (L.) DC.
Uromyces heydsari-paniculati
Digitaria sanguinalis (L.) Scop.
Phyllachora graminis
Piricularia grisea
Ustilago rabenhorstiana
Diodia teres Walt.
Cercospora diodiae-virginianae
Diodia virginiana L.
Peronospora (sp. indet.)
Uromyces spermacoces
Diospyros virginiana L.
Cercospora fuliginosa
Elaphomyces cervinus (Pers.) Schroet.
Cordyceps agariciformia
Elephantopus tomentosus L.
Coleosporium elephantopodis

Erigeron annuus (L.) P.
Ramularia macrospora
Erigeron ramosus (Walt.) BSP
Cercosporella cana
Erysiphe cichoracearum
Puccinia extensicola erigerontis
Erysiphe cichoracearum (DC.) Schroet.
Cicinnobolus cesatii
Eupatorium rotundifolium L.
Puccinia eleocharidis
Euphorbia corollata L.
Erysiphe euphorbiae
Euphorbia presslii Guss.
Piricularia euphorbiae
Fagus grandifolia Ehrh.
Daedalea congragosa
Diatrype virescens
Endothia gyrosa
Polyporus gilvus
Polyporus pargamenus
Polyporus versicolor
Scorias spongiosa
Septobasidium curtisii
Stereum ramale
Streptothrix fusca
Fragaria virginiana Duch.
Ramularia tulasnei
Fraxinus americana L.
Aleurodiscus candidus
Gloeosporium aridum
Phyllosticta viridis
Septobasidium curtisii
Septobasidium pseudopedicellatum
Sphaerographium fraxinii
Thelephora albido-brunnea
Tympanopsis euomphala
Xenosporella berkeleyi
Geranium carolinianum L.
Peronospora geranii
Gillenia stipulata (Muhl.) Trel.
Gymnosporangium externum
Gleditsia triacanthos L.
Linospora gleditsiae
Melasmia hypophylla
Polyporus hirsutus
Sphaeropsis gleditschiicola
Gymnopogon ambiguus (Michx.) BSP.
Dothichloe limitata
Hamamelis virginiana L.
Septobasidium apiculatum
Helianthus angustifolius L.
Puccinia helianthi
Helianthus divaricatus L.
Puccinia helianthi
Rosenscheldia heliopsidis
Helianthus rigidus (Cass.) Desf.
Puccinia helianthi
Helianthus scaberrimus Ell.
Puccinia helianthi
Helianthus strumosus L.
Puccinia helianthi
Hepatica americana (DC.) Ker.
Septoria hepaticae
Hicoria spp.
Aleurodiscus candidus
Crepidopus minutus
Gloeosporium caryae
Microstroma juglandis
Polyporus gilvus
Schizophyllum alneum
Stereum frustulosum
Hieracium venosum L.
Cercospora hieracii
Puccinia hieracii
Sorghum halepense (L.) Pers.
Colletotrichum lineola var. *halepensis*
Holcus lanatus L.
Puccinia rubigo-vera agropyri
Houstonia patens Ell.
Uromyces houstoniatus
Ilex decidua Walt.
Rhytisma ilicinicola
Ilex opaca Ait.
Macroderma curtisii
Phacidium elegantissimum
Rhytisma curtisii
Impatiens biflora Walt.
Puccinia argentea
Puccinia rubigo-vera impatientis
Ipomoea hederaceae Jacq.
Coleosporium ipomoeae
Ipomoea pandurata (L.) G. F. W. Meyer
Albugo ipomoeae-panduranae
Coleosporium ipomoeae
Ipomoea purpurea (L.) Roth.
Albugo ipomoeae-panduranae
Cercospora viridula
Coleosporium ipomoeae
Ipomoea quamoclit L.
Coleosporium ipomoeae
Iris cristata Ait.
Didymellina iridis
Juglans cinerea L.
Marssonia juglandis

Juncus sp.
Uromyces junci

Juniperus virginiana L.
Aleurodiscus nivosus
Bulgaria melastoma
Chlorocyphe cedrina
Chromocrea ceramica
Clithris juniperi
Crucibulum vulgare
Cyathus vernicosus
Fomes annosus
Gymnosporangium clavipes
Gymnosporangium globosum
Gymnosporangium juniperi-virginiae
Gymnosporangium nidus-avis
Keithia juniperi
Lamprospora wrightii
Leocarpus fragilis
Paxina nigrella
Pitya cupressi
Pleurotus applicatus
Polyporus abietinus
Polyporus adustus
Polyporus berkeleyi
Polyporus hirsutus
Polyporus resinosus
Polyporus versicolor
Stereum ramale
Streptothrix fusca
Thelephora albido-brunnea
Trametes heteromorpha

Lactarius spp.
Hypomyces lactifluorum
Sporodinia grandis

Lactuca canadensis L.
Bremia lactucae

Lactuca scariola L.
Bremia lactucae
Cylindrosporium lactucicola
Erysiphe cichoracearum

Lactuca spicata (Lam.) Hitch.
Erysiphe cichoracearum

Lathyrus venosus Muhl.
Uromyces fabae

Leaf mold
Amanita caesarea
Amanita chlorinosma
Amanita muscaria
Amanita phalloides
Amanita solitaria
Amanitopsis vaginata
Astraeus hygrometricus
Calostoma cinnabarina
Calostoma ravenelii
Clitocybe pulcherrima
Craterellus cornucopioides
Helvella crispa
Helvella elastica
Hydnella velutinum
Hydnum imbricatum
Hydnum underwoodii
Leotia stipitata
Lycoperdon curtisii
Lycoperdon mirabilis
Marasmius siccus
Morchella conica
Russula emetica
Russula magna
Russula variata
Scleroderma cepa
Simblum sphaerocephalum
Strobilomyces strobilaceus
Thelephora caespitulans
Wolfina aurantiopsis

Lecanium sp.
Fusarium aleyrodis
Cordyceps clavulata

Lenzites betulina (L.) Fr.
Dactylium dendroides

Leptilon canadense (L.) Britt.
Basidiophora entospora
Cercosporella cana

Lespedeza hirta (L.) Ell.
Uromyces lespedezae-procumbentis

Lespedeza repens (L.) Bart.
Uromyces lespedezae-procumbentis

Liquidambar styraciflua L.
Cercospora liquidambaris
Daedalea confragosa
Endothia gyrosa
Leptothyriella liquidambaris
Panus rudis
Peniophora mutata
Psathyrella disseminata
Stereum fuscum
Stereum ramale
Stereum sericeum
Tremella lutescens

Liriodendron tulipifera L.
Armillaria mellea
Cercospora liriodendri
Erysiphe polygoni
Manina cordiformis

Phyllosticta liriodendrica
Pleurotus ostreatus
Pleurotus ulmarius
Polyporus hirsutus
Polyporus tulipiferus
Polyporus versicolor
Toruloidea tulipifera
Lyonia ligustrina (L.) DC.
Rhytisma decolorans
Mikania scandens (L.) Willd.
Puccinia spegazzinii
Morus rubra L.
Acrospermum compressum
Cercosporella arachnoidea
Mycosphaerella arachnoidea
Mycosphaerella mori
Phleospora mori
Myosotis virginica (L.) BSP.
Puccinia eatoniae-myosotidis
Nyssa sylvatica Marsh.
Manina cordiformis
Myriangium curtisii
Myriangium duriaei
Septobasidium curtisii
Oenothera biennis L.
Erysiphe polygoni
Septoria oenotherae
Oenothera fruticosa L.
Puccinia extensicola oenotherae
Oenothera laciniata Hill
Erysiphe polygoni
Puccinia extensicola oenotherae
Septoria oenotherae
Synchytrium fulgens
Uromyces plumbarius
Oxydendrum arboreum (L.) DC.
Mycosphaerella caroliniana
Phyllosticta oxydendri
Panicum boscii Poir.
Tetraploa divergens
Paspalum dilatatum Poir.
Claviceps paspali
Paspalum floridanum Michx.
Claviceps paspali
Paspalum laeve Michx.
Claviceps paspali
Passiflora incarnata L.
Cercospora fuscovirens
Cereospora truncatella
Penstemon canescens Britt.
Puccinia andropogonis penstemonis
Penstemon laevigatus Sol.
Puccinia andropogonis penstemonis
Phragmidium potentillae (Pers.) Karst.
Darluca filum
Phytolacca decandra L.
Cercospora flagellaris
Pinus spp.
Arcyria nutans
Arrhytidia involutus
Claudopus nidulans
Coniophora olivascens
Craterium leucocephalum
Cronartium quercuum
Daedalea confragosa
Dasyscypha ellisiana
Dictydium cancellatum
Dictydium cancellatum var. *anomalum*
Dictydium cancellatum var. *purpureum*
Ditiola radicata
Exidia glandulosa
Fomes annosus
Fomes pini
Hypocrea lenta
Lachnobolus occidentalis
Lentinus umbilicatus
Lenzites saepiaria
Merulius ambiguus
Peniophora gigantea
Physarum citrinum
Physarum pulcherripes
Pleurotus applicatus
Polyporus abietinus
Polyporus adustus
Polyporus caesius
Polyporus cinnabarinus
Polyporus cinnamoneus
Polyporus pargamenus
Polyporus schweinitzii
Polyporus ursinus
Poria cocos
Poria ferruginea
Poria ruba
Poria subfusco-flavida
Schizophyllum alneum
Sparassis crispa
Stemonitis fenestrata
Stictis radiata
Tremella pinicola
Tremellodon gelatinosum
Pine cones
Scoleconectria scolecospora

Pinus echinata Mill.
Coleosporium vernoniae
Lophodermium pinastri
Septoria acicola

Pinus palustris Mill.
Septoria acicola

Pinus taeda L.
Coleosporium solidaginis
Coleosporium vernoniae
Lophodermium pinastri
Septoria acicola

Plantago aristata Michx.
Peronospora plantaginis

Plantago lanceolata L.
Erysiphe cichoracearum

Plantago major L.
Erysiphe cichoracearum

Plantago rugelii Decaisne
Erysiphe cichoracearum

Platanus occidentalis L.
Cercospora platanifolia
Diatrypella prominens
Discosia artocreas
Ganoderma lucidum
Gloeosporium nervisequum
Gnomonia veneta
Manina cordiformis
Microsphaera alni
Mycosphaerella platanifolia
Mycosphaerella stigmina-platani
Polyporus adustus
Poryporus gilvus
Polyposus versicolor
Stigmina platani
Trogia crispa
Xenosporella berkeleyi

Poa pratensis L.
Puccinia graminis var. *poae*

Podophyllum peltatum L.
Puccinia podophylli

Polycodium neglecta (L.) Small
Rhytisma vaccinii

Polygonum pennsylvanicum L.
Cercospora hydropiperis

Polygonum spp.
Puccinia polygoni-amphibii convolvuli

Polystichum acrostichoides (Michx.) Schott.
Taphrina polystichi

Potamogeton natans L.
Doassansia martianoffiana

Potentilla canadensis Raf.
Phragindium potentillae

Potentilla pumila Poir.
Dothidea potentillae
Phragmidium potentillae
Stigmatea potentillae
Taphrina potentillae

Prenanthes sp.
Erysiphe cichoracearum

Prenanthes altissimus L.
Cercospora brunnea

Prunus americana Marsh.
Caryospora putanimum
Fomes pomaceus
Sclerotinia fructicola
Stereum ramale
Taphrina mirabilis

Prunus angustifolia Marsh.
Sclerotinia fructicola
Taphrina mirabilis

Prunus avium L.
Plowrightia morbosa

Prunus cerasus L.
Cercospora cerasella
Cylindrosporium hiemalis
Transchelia pruni-spinosae

Prunus persica (L.) Stokes
Caryospora putaminum
Cercosporella persica
Cladosporium carpophilum
Mycosphaerella persica
Sclerotinia fructicola
Taphrina deformans
Transchelia pruni-spinosae

Prunus serotina Ehrh.
Cylindrosporium lutescens
Monilia cinerea
Polyporus cinnabarinus
Stereum sericeum
Taphrina varius
Transchelia pruni-spinosae

Prunus virginiana L.
Taphrina varius

Psedera quinquefolia (L.) Greene
Guignardia bidwellii

Pteridium latiusculum (Desv.) Hieron.
Phyllachora pteridis
Uredinopsis macrosperma

Pyrrhopappus carolinianus (Walt.) DC.
Puccinia hieracii

Pyrus coronaria L.
Gymnosporangium juniperi-virginianae

Pyrus malus L.
Corticium lilacino-fuscum
Fomes pomaceus
Nummularia discreta
Polyporus tulipiferus
Pyrus prunifolia Willd.
Sphaeropsis malorum
Quercus spp.
Arachnopeziza aurelia
Arcyria denudata
Armillaria mellea
Claudopus nidulans
Clithris quercina
Comatrichia nigra
Corticium lilacino-fuscum
Coryne sarcoides
Crepidopus minutus
Cronartium quercuum
Cyathus striatus
Daedalea confragosa
Daldinia concentrica
Daldinia vernicosa
Diatrype albopruinosa
Diatrype stigma
Endothia gyrosa
Exidia recisa
Fomes applanatus
Fomes igniarius
Ganoderma curtisii
Ganoderma lucidum
Glonium stellatum
Hemitrichia clavata
Hemitrichia serpula
Hemitrichia vesparium
Hymenochaete corrugata
Hymenochaeta curtisii
Hymenochaete sallei
Hypoxylon atropunctum
Hypoxylon punctulatum
Hypoxylon rubiginosum
Hypoxylon truncatum
Hysterographium vulvatum
Irpex pachydon
Lenzites betulina
Leocarpus fragilis
Marasmius resinosus
Marasmius rotula
Merulius incarnatus
Merulius tremellosus
Mycena corticola
Myrangium duriaei
Panus rudis
Panus tortulosus
Patella albida
Patella scutellata
Peniophora mutata
Penzigia frustulosa
Pleurotus ostreatus
Pleurotus petaloides
Pleurotus spathulatus
Pleurotus ulmarius
Pluteus cervinus
Pluteolus reticulatus
Polyporus adustus
Polyporus arcularius
Polyporus cinnabarinus
Polyporus cinnamomeus
Polyporus frondosus
Polyporus gilvus
Polyporus graveolens
Polyporus hirsutus
Polyporus pargamenus
Polyporus picipes
Polyporus sanguineus
Polyporus sulphureus
Polyporus tulipiferus
Polyporus versicolor
Poria versipora
Rosellinia subiculata
Schizophyllum alneum
Septonema olivaceum
Stemonitis fusca
Stereum fasciatum
Stereum frustulosum
Stereum gausapatum
Stereum lobatum
Stereum ramale
Stereum sericeum
Stereum subpileatum
Streptothrix fusca
Taphrina caerulescens
Tremella fuciformis
Trogia crispa
Urnula craterium
Xylaria hypoxylon
Quercus alba L.
Aleurodiscus candidus
Alcurodiscus oakesii
Daedalea unicolor
Manina cordiformis
Marasmius fagineus
Microsphaera alni var. *extensa*
Phyllactinia corylea
Psathyrella disseminata
Thelephora albido-brunnea

Quercus borealis maxima (Marsh) Ashe
Aulographum quercinum
Microsphaera alni var. *extensa*
Septoria quercicola

Quercus marilandica Muench.
Polyporus obtusus
Taphrina caerulescens

Quercus phellos L.
Microsphaera alni
Polyporus hispidus
Septobasidium castaneum

Quercus prinus L.
Trichia favoginea

Quercus rubra L.
Microsphaeri alni

Quercus stellata Wang.
Aleurodiscus candidus
Aleurodiscus oakesii
Fomes everhartii
Polyporus obtusus

Quercus velutina Lam.
Aulographum quercinum
Fomes everhartii
Leptosphaeria dryophila
Manina cordiformis
Polyporus obtusus

Rhododendron catawbiense Michx.
Exobasidium vaccinii

Rhus copallina L.
Cercospora rhoina
Taphrina purpurascens

Rhus toxicodendron L.
Pileolaria toxicodendri
Polyporus versicolor
Schyzophyllum alneum
Stereum ramale

Rhynchosia erecta (Walt.) DC.
Parodiella perisporioides

Rhynchosia tomentosa (L.) H. & A.
Parodiella perisporioides

Rosa virginiana L.
Cercospora rosicola
Phragmidium americanum
Sphaerotheca pannosa

Rubus spp.
Cercospora rubi
Cercosporella rubi
Cylindrosporium rubi
Discosia artocreas
Fusarium rubi
Gymnoconia interstitialis
Kunkelia nitens
Mycosphaerella confusa
Mycosphaerella rubi
Septoria rubi

Rubus argutus Link.
Kuehneola uredinis

Rubus trivialis Michx.
Gymnoconia peckiana

Rumex acetosella L.
Cercospora acetosellae
Puccinia acetosae

Rumex crispus L.
Ovularia obliqua

Russula sp.
Sporodinia grandis

Sabbatia angularis (L.) Pursh.
Cercospora sabbatiae

Salix nigra Marsh.
Daedalea confragosa
Melampsora bigelowii
Melampsora abieti-caprearum
Mycena alkalina
Pleurotus ulmarius
Polyporus adustus
Polyporus hirsutus
Schizophyllum alneum
Trogia crispa
Uncinula salicis

Sambucus canadensis L.
Cercospora catenospora
Puccinia bolleyana
Puccinia marylandica

Sassafras variifolium (Salisb.) Kze.
Polyporus hirsutus

Scirpus sp.
Puccinia angustata

Silphium asteristicus L.
Coleosporium terebinthinaceae

Silphium integrifolium L.
Coleosporium terebinthinaceae

Smilacina racemosa (L.) Desf.
Phyllosticta convallariae
Phyllosticta palladior

Smilax sp.
Diachea leucopodia
Diatrype infuscans

Smilax glauca Walt.
Cercospora mississippiensis
Cercospora smilacina
Hysterium smilacis

Smilax hispida Muhl.
Puccinia smilacis

Sisymbrium thalianum (L.) J. Gay
Albugo candida
Peronospora parasitica
Soil
Agaricus campestris
Agaricus silvicicola
Calvatia craniformis
Calvatia cyathiformis
Calvatia rubro-flava
Cantharellus aurantiacus
Cantharellus cinnabarinus
Cephaliophora tropica
Craterellus octrosporus
Discina apiculata
Geaster arenarius
Geaster coronarius
Geaster velutinus
Lactarius piperatus
Lactarius subplinthogalus
Lycoperdon peckii
Lycoperdon pulcherrimum
Lycoperdon umbrinum
Marasmius rubophyllus
Patella melaloma
Peziza repanda
Pisolithus tinctorius
Pseudoplectania nigrella
Scleroderma geaster
Scleroderma lycoperdoides
Thelephora palmata
Thelephora regularis
Thelephora terrestris
Tremellodendron candidum
Tremellodendron merismatoides
Tylostoma simulans
Wolfina aurantiopsis
Solidago altissima L.
Puccinia extensicola solidaginis
Solidago canadensis L.
Coleosporium solidaginis
Puccinia extensicola solidaginis
Solidago sp.
Phyllachora solidaginum
Sorghastrum nutans (L.) Nash.
Puccinia virgata
Sphenopholis obtusata (Michx.) Scribn.
Epichloe typhina
Sphingidae
Cordyceps sphingum
Sporobolus poiretii (Roem. & Schult.) Hitch.
Helminthosporium ravenelii
Staphylea trifolia L.
Ovularia isarioides
Steironema ciliatum (L.) Raf.
Ramularia lysimachiae
Stellaria media (L.) Cyrill.
Peronospora alsinearum
Synchytrium stellariae
Strophostyles umbellata (Muhl.) Britt.
Uromyces phaseoli var. *strophostylis*
Taraxacum officinale Weber
Ramularia lineola
Sphaerotheca humuli
Tecoma radicans (L.) Juss.
Cercospora sordida
Favolus ciliaris
Trogia crispa
Tephrosia virginiana (L.) P.
Ravenelia epiphylla
Trifolium hybridum L.
Uromyces trifolii-hybridi
Trifolium pratense L.
Erysiphe polygoni
Trifolium procumbens L.
Erysiphe cichoracearum
Trifolium repens L.
Cymadothea trifolii
Uromyces trifolii-hybridi var. *trifolii-repentis*
Triodia flava (L.) Smyth.
Puccinia windsoriae
Tripsacum dactyloides L.
Claviceps tripsaci
Puccinia polysora
Puccinia tripsaci
Ulmus alata Michx.
Acrospermum compressum
Phleospora ulmi
Phyllactinia corylea
Polyporus conchifer
Septobasidium pseudopedicellatum
Uncinula intermedia
Uncinula macrospora
Ulmus americana L.
Gloeosporium ulmeum
Gnomonia ulmea
Mycosphaerella ulmi
Phleospora ulmi
Polyporus conchifer
Septobasidium pseudopedicellatum
Ulmus fulva Michx.
Mycosphaerella ulmi
Phleospora ulmi

Vaccinium spp.
Rhytisma vaccinii
Vaccinium tenellum Ait.
Exobasidium vaccinii
Microsphaera alni var. *vaccinii*
Verbascum blattaria L.
Septoria verbascicola
Verbesina occidentalis (L.) Walt.
Puccinia verbesinae
Verbesina virginica L.
Coleosporium viguierae
Vernonia altissima Nutt.
Coleosporium carneum
Coleosporium vernoniae
Viburnum affine Bush.
Microsphaera alni
Viburnum rufidulum Raf.
Thelephora albido-brunnea
Vicia spp.
Ascochyta viciae
Protocoronospora nigricans
Vicia angustifolia Reichard
Ascochyta viciae
Peronospora viciae var. *americanum*
Viola spp.
Cercospora macrospora
Puccinia violae
Vitis rotundifolia Michx.
Guignardia bidwellii
Hysterographium viticola
Vitis vinifera L.
Plasmopora viticola
Wood
Arcyria digitata
Arcyria incarnata
Arcyria magna
Arcyria pomiformis
Auricularia auricula-judae
Badhamia capsulifera
Bulgaria rufa
Ceratiomyxa fruticulosa
Chaetosphaeria pannicola
Coccospora aurantiaca
Cribraria intricata
Cribraria microcarpa
Crucibulum vulgare
Dictydiaethalium plumbeum
Didymium crustaceum
Didymium nigripes
Enteridium rozeanum
Everhartia lignitalis
Fomes fomentarius
Fuligo septica
Geoglossum glabrum
Guepinia elegans
Guepinia spathularia
Hydnum adustum
Lasiosphaeria strigosa
Lycogala epidendrum
Lycoperdon gemmatum
Lycoperdon pyriforme
Lycoperdon subincarnatum
Manina flagellum
Microglossum olivaceum
Microglossum rufum
Omphalia epichysium
Orbilia chrysocoma
Patella setosa
Peniophora albomarginata
Physarum globuliferum
Physarum oblatum
Physarum pulcherrimum
Physarum viride
Platygloea caroliniana
Plectania occidentalis
Polyporus distortus
Polyporus montagnei
Rosellinia aquila
Sporodesmium concinnum
Stemonites axifera
Stemonites pallida
Stemonitis smithii
Stemonitis splendens
Tapesia fusca
Trichia botrytis
Trichia decipiens
Trichia persimilis
Trichoderma lignorum
Trichoglossum hirsutum
Tuberculariа vulgaris
Ustulina vulgaris
Wolfina aurantiopsis
Xylaria polymorpha
Xanthium spp.
Erysiphe cichoracearum
Puccinia xanthii
Zephyranthes atamosco (L.) Herb.
Puccinia cooperiae

Date Due

Additional Copies
of this Bulletin may be obtained from the
DEAN, SCHOOL OF FORESTRY,
DUKE UNIVERSITY, DURHAM, NORTH CAROLINA,
at $1.00 per copy.

634.906 D877F no.2 c.2 354117

MAY 3 1972
JUN 1 1972

School of Forestry

THIS VOLUME DOES NOT CIRCULATE
OUTSIDE THE BUILDING